RECEIVED 11/26/02

Main #: (201) 641-2552
Fax: (201) 641-6407

BERGEN COUNTY UTILITIES AUTHORITY

Box 9, Foot of Mehrhof Road, Little Ferry, New Jersey 07643

JEROME SHEEHAN
Executive Director

November 20, 2002

Ms. Janet Conetta
Strategic Integration Manager
Emergency and Remedial Response Division
U.S. Environmental Protection Agency
Region 2
290 Broadway
New York, New York 10007-1866

Re: Request for Information:
"Berry's Creek Superfund Study Area, Bergen County, New Jersey"

Dear Ms. Conetta:

Please be advised that the undersigned serves as Executive Director for The Bergen County Utilities Authority ("Authority").

Enclosed please find the Authority's responses to the United States Environmental Protection Agency's Request for Information dated October 11, 2002, together with supporting documents.

Kindly acknowledge receipt of the Authority's responses by executing a copy of this correspondence in the space provided for your signature and return it to me in the self-addressed envelope provided for your convenience.

Very truly yours,

Jerome F. Sheehan

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Executive Director

JFS:sk

82566

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JFS:sk

I hereby acknowledge receipt of the Authority's responses to the Request for Information, dated October 11, 2002, on November ______, 2002.

By:______________________________

BERGEN COUNTY UTILITIES AUTHORITY
WATER POLLUTION CONTROL DIVISION

RESPONSE
TO THE
USEPA REQUEST FOR INFORMATION
REGARDING
BERRY'S CREEK SUPERFUND STUDY AREA

1. a. Bergen County Utilities Authority
Foot of Mehrhof Road
Post Office Box 9
Little Ferry, NJ 07643

b. In 1947, the Board of Chosen Freeholders of Bergen County established the Bergen County Sewer Authority under an act of the New Jersey legislature. The Authority was delegated the responsibility for the construction, administration, operation and maintenance of trunk sewers, intercepting sewers, and sewage treatment facilities to eliminate pollution of the Hackensack River and its tributaries.

The Bergen County Utilities Authority is the successor agency to the Bergen County Sewer Authority. The Authority is organized in accordance with "Municipal and Counties Utilities Authorities Law" NJSA. 40:14B-1 et seq.

c. Commissioners:
Benedict A. Focarino, Chairman
Joseph Tedeschi. Vice Chairman
Eugene Becken
James Cassella
John Glidden, Jr.
Skip Kelley
Roger Mattei
Frank Raimondo

Staff:
Jerome F. Sheehan, Executive Director/Chief Engineer
Eric Andersen, Plant Manager

2. a. The site is located on the west side of the Hackensack River and covers approximately 140 acres. The site can be entered from the north in Little Ferry using Mehrhof Road and from the south in Moonachie using Empire Boulevard.

b. Coordinate Centroid =- 1983 NJ State Plane Coordinates
Easting: 621,500.00
Northing: 729,000.00

10/29/02

c. Little Ferry Tax Map Block 106, Lots 1 through 13, 13A, 13B, and 13C

3. The BCUA facility in Little Ferry has been in operation since 1949. The BCUA has operated its pumping station on the former site of the JMRERC sewage treatment plant and the associated forcemain since 1987.

4. The main permit under which the BCUA operates is its NJPDES Permit No. NJ0020028. The BCUA has numerous other permits including air pollution permits, stormwater, stream encroachment, etc. under which it operates.

5. a. The Commissioners of the BCUA are responsible for the operation of the plant site. The Commissioners are appointed by the Bergen County Executive and approved by the Bergen County Board of Chosen Freeholders. There is also a full time staff hired by the Commissioners that is responsible for the day to day operations. The licensed operator of the BCUA's sewage treatment plant in Little Ferry and the interceptor collection system is Jerome F. Sheehan, Executive Director /Chief Engineer

b. The BCUA's plant site and sewage interceptor collection system is owned and operated by the BCUA. The municipal sewage collection systems are owned and operated by the municipalities. The BCUA is a regional sewerage authority that serves 46 municipalities. Each of these municipalities owns and operates its respective collection system.

6. (1) The BCUA has no contractual relationship with the Joint Meeting of Rutherford, East Rutherford and Carlstadt (JMRERC). The JMRERC operated a sewage interceptor system and treatment plant in Rutherford. The BCUA constructed a pumping station and forcemain on the site of the JMRERC. The sewage flow that was previously treated by the JMERRC treatment plant was diverted to the BCUA's facilities in 1987. The BCUA has a separate service agreement with each of the municipalities that constitute the JMRERC.

(2) The BCUA has not had any involvement with or in the Borough of Carlstadt Sewerage Treatment Plant.

7. Attached are the plans of BCUA's facilities that were constructed to divert the flow from the JMRERC to the BCUA. Also attached is a general description of the BCUA's sewerage treatment facilities entitled Overview of Bergen County Utilities Authority dated May 1995, the Joint Meeting Extension Facility Plan dated May 1977, and the Sewer System Evaluation Report for the Rutherford-East Rutherford-Carlstadt Joint-Meeting dated March 1984.

8. 001A Sanitary Outfall. Since 1949, the BCUA is authorized to discharge treated sanitary sewage to the Hackensack River (SE-2), via a discharge channel, through

Discharge Serial Number (DSN) 001, at latitude 40° 49'54", longitude 74° 01'57".

9. The BCUA is not aware of any leaks, spills, or discharges from any of its facilities in Rutherford that are adjacent to the Berry's Creek study area.

10. See 9 above.

11. Attached is a list of all industries in Rutherford, East Rutherford and Carlstadt that are permitted under the BCUA's Industrial Pretreatment Program

12. Jerome F. Sheehan
28 Prest's Mill Rd
Old Bridge NJ 08857

    Eric Andersen, Manager
281 Glenwood Avenue
Leonia, NJ 07605

13. The information provided herein was obtained from general knowledge of the staff and the information provided in answer 7.

BCUA Industrial Pretreatment Program
Permitted Facilities
in
Carlstadt, East Rutherford, and Rutherford

Agt•Seven	1 Kero Road	Carlstadt
Aluminum Anodizing Inc.	500 13th Street	Carlstadt
Burger Maker	666 16th Street	Carlstadt
Citroil Enterprises, Inc.	320 Veterans Boulevard	Carlstadt
Cognis Corp.	Berry Avenue At Route 17 North	Carlstadt
Cosan Chemical Corp.	400 Fourteenth Street	Carlstadt
Dover Diesel Service	130 Moonachie Avenue	Carlstadt
Elektromek Inc.	20th & Broad Streets	Carlstadt
Flex Products	640 Dell Road	Carlstadt
J.Manheimer, Inc.	700 Gotham Parkway	Carlstadt
Krohn Industries, Inc.	303 Veterans Boulevard	Carlstadt
Manhattan Products	333 Starke Road	Carlstadt
Novus Fine Chemicals	611-641 Broad Street	Carlstadt
Pantone, Inc.	590 Commerce Boulevard	Carlstadt
Plc Enterprises	700 Gotham Parkway	Carlstadt
Potters Industries Inc.	600 Industrial Road	Carlstadt
Prospect Transportation	583 Industrial Road	Carlstadt
Ryder Truck Rental	125 Commercial Avenue	Carlstadt
Stanbee Co. Inc.	70 Broad Street	Carlstadt
Tec Cast, Inc.	440 Meadow Lane	Carlstadt
Thumann, Inc.	670 Dell Road	Carlstadt
Tunnel Barrel & Drum Co., Inc.	85 Triangle Blvd.	Carlstadt
U.S.A. Industries, Inc.	111 Kero Road	Carlstadt
Water-Jel Technology	243 Veterans Boulevard	Carlstadt
Yoo-Hoo Chocolate Beverage Corp.	600 Commercial Avenue	Carlstadt
Ambix Laboratories	210 Orchard Street	East Rutherford
Becton Dickinson	Stanley Street	East Rutherford
Diamond Chemical	Union Ave & Dubois Street	East Rutherford
Pse&G, East Rutherford Gas Works	153 Union Avenue	East Rutherford
Safer Prints, Inc.	450 Murray Hill Parkway	East Rutherford
Stone Surfaces, Inc.	890 Paterson Plank Road	East Rutherford
Howmedica Osteonics Corp.	359 Veterans Blvd.	Rutherford

BERGEN COUNTY UTILITIES AUTHORITY

LITTLE FERRY, NEW JERSEY

OVERVIEW OF THE BERGEN COUNTY UTILITIES AUTHORITY WATER POLLUTION CONTROL DIVISION

- OPERATIONS
- REGULATORY ISSUES
- PERSONNEL
- BUDGET
- USER CHARGES

MAY 1995

PRESENTED BY:
THE STAFF OF THE WATER POLLUTION CONTROL DIVISION

JEROME F. SHEEHAN, P.E.
CHIEF ENGINEER

Bergen County Utilities Authority

Water Pollution Control Division

Overview of the Bergen County Utilities Authority Water Pollution Control Division

- Operations
- Regulatory Issues
- Personnel
- Budget
- User Charges

MAY 1995

Presented by:
The Staff of the Water Pollution Control Division

Jerome F. Sheehan, P.E.
Chief Engineer

Overview of the Bergen County Utilities Authority Water Pollution Control Division

Table of Contents

1.0 Introduction

The earliest systems for collecting and disposing of domestic wastewater were designed merely to remove wastes from densely populated urban areas and release them into surface waters where they would be diluted and carried downstream. As populations in these urban centers expanded, increasing volumes of untreated sewage began to degrade surface waters and cause frequent outbreaks of waterborne disease. The safe and effective treatment of sanitary wastewaters became necessary to protect the health and well-being of the public. The safe treatment and disposal of wastewater became one of the functions of local governments.

Modern wastewater treatment has reduced the occurrence of waterborne pathogens so effectively that incidences of diseases such as typhoid, cholera and dysentery have been virtually eliminated in the United States. Wastewater treatment plants, while successfully preventing the spread of disease, may still degrade the quality of receiving waters if effluents are released in an uncontrolled fashion. For this reason, federal and state governments have promulgated an array of laws and regulations to control the discharge of pollutants from wastewater treatment plants. Today, the agencies providing wastewater treatment services are expected to perform many water pollution control functions that go beyond traditional sewage treatment operations.

The Bergen County Utilities Authority (BCUA) and other wastewater treatment agencies throughout the state and the nation have invested billions of dollars in the construction and operation of collection and treatment systems. In response to increasingly numerous and complex environmental regulations, the pollution control responsibilities of wastewater treatment agencies have expanded in recent decades to encompass pollutants and pollutant sources that have required innovative, and sometimes costly, methods of control. Some of these new challenges include treatment and control of toxic pollutants, removal of nutrients, reduction of infiltration and inflow, and mitigation of combined sewer overflows. Addressing these issues in a technically sound and fiscally responsible manner is the responsibility of the BCUA and other agencies across the nation providing wastewater treatment services.

This report is intended to provide general information regarding the BCUA wastewater treatment operation for those individuals who are called upon to make decisions regarding the future of the agency. It includes a description of the basic wastewater treatment process and the personnel responsible for the various wastewater treatment functions. Also included is a review of the legislative history underlying the actions taken by the BCUA to satisfy regulatory mandates, and an explanation of some future issues which are likely to have serious fiscal implications for the BCUA and its ratepayers.

2.0 Wastewater Treatment Systems

2.1 Overview

The wastewater treatment function performed by the BCUA depends on the successful operation of two separate systems. The collection system consists of the complex network of sewer pipes, conduits, pumping equipment, and other appurtenances required to convey the wastewater from individual residences, commercial establishments and industries to a central location for treatment. Once collected, the wastewater treatment system processes the wastewater so that it may be discharged to the Hackensack River in a manner that is safe for human health and the environment. The wastewater treatment system is actually designed to treat both the wastewater that enters the plant and the sludge that is generated as a byproduct of the wastewater treatment process. The functions are distinct and will be addressed individually.

2.2 Collection System

There are three categories of municipal collection systems; storm sewers, sanitary sewers and combined sewers. Systems that convey stormwater runoff and other drainage directly to surface waters while excluding sanitary wastes are considered storm sewers. Systems that receive wastewater from residential, commercial or industrial sources along with relatively small amounts of groundwater infiltration or stormwater inflow are considered sanitary sewers. Sewers that convey both sanitary wastes and stormwater are referred to as combined sewers. The operation and maintenance of storm sewers are the responsibility of individual municipalities and are, therefore, beyond the scope of the BCUA's water pollution control responsibilities. Combined sewers are present in Fort Lee, Hackensack, and Ridgefield Park. While combined sewers are also a municipal responsibility, the BCUA treatment plant does receive discharge from combined sewers.

The BCUA operates a system of gravity sewer lines, pumping stations and forcemains that receive the discharge of wastewater from the individual municipal collection systems and transports the wastewater to the treatment plant in Little Ferry. A gravity sewer is sloped downward so that the wastewater flows toward the treatment plant. When the topography is such that the construction of gravity sewers creates very deep sewer lines, a pumping station is built to lift the sewage to a level that will allow it to once again flow by gravity. Typically, pumped sewage is discharged into a forcemain, which is a pressurized line that eventually feeds into a gravity sewer.

The BCUA does not own or operate the local collection systems. Traditionally, each Bergen County municipality independently constructed its own sanitary sewer system and sewage treatment plant when necessary for public health reasons. As such, many of the municipal collection systems predate the formation of the BCUA in 1947. Generally, the materials and methods used for sewer construction were greatly improved after 1950. Pipes with better and fewer joints were available and became the standard for the industry, making sewers more impermeable. Older systems allow groundwater to enter the sewers, which is referred to as infiltration. It was also standard practice in the past to connect stormwater conveyance systems, such as roof leaders and sump pumps, to the sanitary sewers so that local flooding problems could be alleviated. This is known as inflow. Infiltration and inflow present engineering and regulatory challenges for the BCUA and for many municipalities within the BCUA service area.

The BCUA began constructing its collection system in 1948. The system consists of the trunk and intercepting sewers which convey the wastewater flow from the municipal collection systems to the treatment plant in Little Ferry. Each subsequent construction phase connected additional municipalities to the system. With the completion of the most recent expansion in 1992, the collection system now encompasses approximately 85 miles of sewer lines and 9 pumping stations serving all or part of 46 municipalities in Bergen County. A list of these municipalities and their date of entry into the BCUA system is provided as Table 2-1.

Three separate trunk sewer systems collect and transport wastewater to the BCUA treatment plant. The first trunk sewer constructed by the BCUA was the Overpeck Trunk Sewer which extends from Little Ferry to Tenafly. Interceptor sewers were also constructed which allowed 12 municipalities in the Overpeck Valley to abandon their sewage treatment plants and discharge wastewater to the BCUA. This construction was completed in 1951. The next expansion of the service area occurred through construction of the Hackensack Valley Trunk Sewer. This second stage, completed in 1964, extended from Little Ferry to Westwood and added 16 municipalities to the system. The service area was also expanded to the southwest through the construction of the Southwest Trunk Sewer which extends from Little Ferry to Hasbrouck Heights. This third trunk sewer system was completed in 1972. Additionally, two major subsystems were completed in 1976 extending service to the Pascack Valley and Northern Valley areas of Bergen County. Both of these subsystems discharge to the Hackensack Valley Trunk Sewer.

Measuring the amount of wastewater produced by each municipality is important for both operating and billing purposes. To accomplish this task, the BCUA has constructed 166 metering chambers throughout the service area. The typical BCUA metering chamber is an underground concrete vault that contains a metering device known as a Parshall flume. A Parshall flume contains a mechanism to measure the depth of flow, which is then converted to a flow rate using a mathematical formula. The data is recorded mechanically on a chart at the meter site. The depth measuring device must be calibrated at least once every three months to assure accuracy. Charts are changed weekly.

Bergen County Utilities Authority
Water Pollution Control Division

Table 2-1

Member Municipalities and Date of Entry Into System

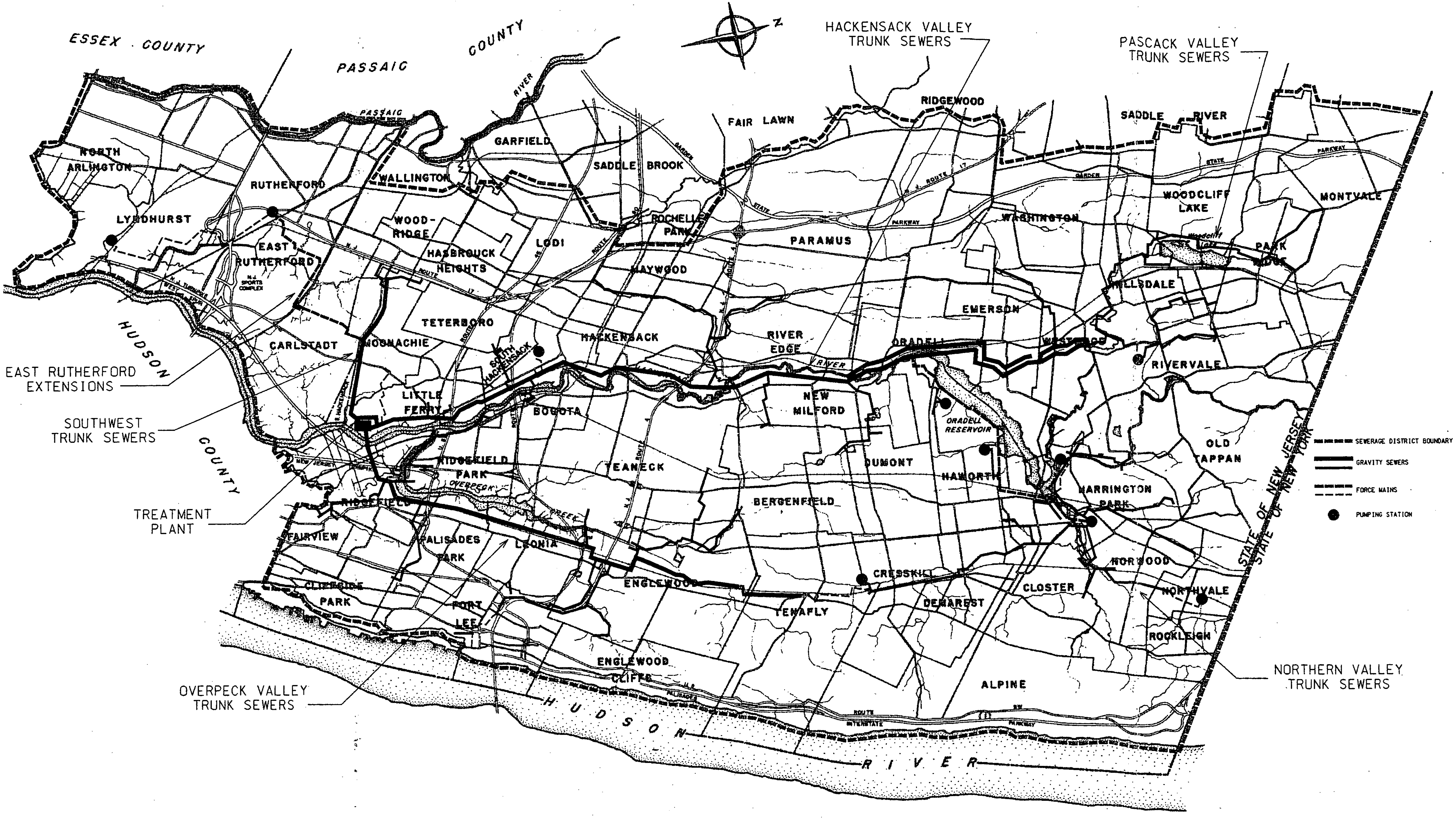
Bergenfield	1960	Moonachie	1961
Bogota	1960	New Milford	1960
Carlstadt	1967	Northvale	1972
Cliffside Park	1951	Norwood	1972
Closter	1972	Old Tappan	1990
Cresskill	1957	Oradell	1960
Demarest	1972	Palisades Park	1951
Dumont	1965	Paramus	1960
East Rutherford	1970	Park Ridge	1968
Emerson	1960	Ridgefield	1951
Englewood	1951	Ridgefield Park	1951
Englewood Cliffs	1957	River Edge	1960
Fairview	1951	River Vale	1972
Fort Lee	1951	Rochelle Park	1960
Hackensack	1960	Rutherford	1990
Harrington Park	1972	South Hackensack	1960
Hasbrouck Heights	1967	Teaneck	1951
Haworth	1972	Tenafly	1951
Hillsdale	1967	Teterboro	1960
Leonia	1951	Washington Twsp.	1970
Little Ferry	1960	Westwood	1960
Maywood	1960	Woodcliff Lake	1968
Montvale	1970	Wood-Ridge	1992

The nine BCUA pumping stations were constructed on the outer reaches of the service area except for the largest station which is located in Harrington Park and serves the Northern Valley region. All BCUA pumping stations are designed to run automatically and do not require personnel on a 24-hour per day basis. Each station contains its own electrical generating facilities in the event that normal power is lost. The pumping stations require periodic cleaning of the wet wells to remove the buildup of grit and other materials that are not removed by the pumps. The BCUA collection system, including the nine pumping stations, is depicted in Figure 2-1.

The Northern Valley extension of the BCUA collection system circumnavigates the Oradell Reservoir owned by the Hackensack Water Company. Five of the nine BCUA pumping stations are located within the reservoir watershed. Since the discharge of wastewater into the reservoir has the potential to contaminate a significant portion of the drinking water supply for Bergen County, the pumping stations, forcemains, and other parts of the collection system located in this region receive proportionally greater attention due to the impact that sewage overflow would have on this system.

2.3 Wastewater Treatment Process

Before a wastewater can be discharged into a surface water, such as the Hackensack River, the materials that are undesirable from a public health and aesthetic standpoint must be removed. These materials include, at a minimum, the particles that settle easily out of the wastewater stream, the organic matter that may be biodegraded, and the pathogenic organisms that pose a public health risk. Modern wastewater treatment has evolved as a multistep process to accomplish the tasks of settling, biological treatment and disinfection.



DISTRICT SEWER SYSTEM

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The presence of dissolved oxygen is of fundamental importance in maintaining aquatic life and the aesthetic quality of surface waters. Therefore, one of the goals of wastewater treatment is insuring that the biodegradable material discharged from the treatment plant does not result in an oxygen demand that the receiving system cannot support. Both biochemical and chemical oxidation of organic material occurs in the aquatic environment, but in terms of oxygen demand, the most important reactions are biochemical. Biochemical reactions refer to the reactions that are carried out by the metabolic activity of microorganisms, principally bacteria. These organisms use oxygen to oxidize the carbon in organic matter to CO_2, thereby producing the energy necessary to live and reproduce. A wastewater treatment plant is designed so that microorganisms may carry out these biochemical reactions within the confines of the plant, rather than in the aquatic environment.

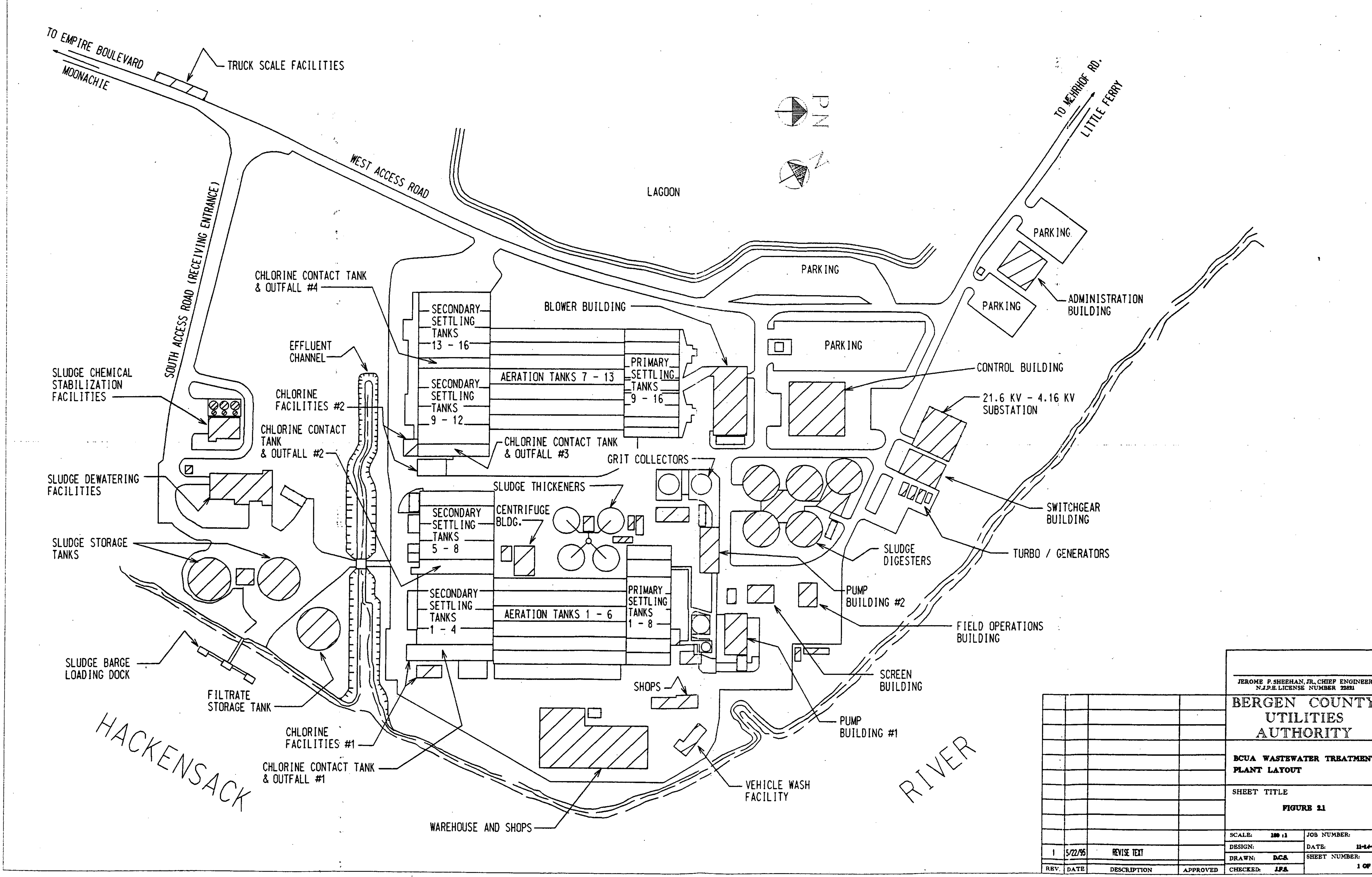
The amount of oxygen used in the metabolism of microorganisms to decompose biodegradable material is termed Biochemical Oxygen Demand (BOD). Since the biodegradable material entering a wastewater treatment plant is a broad mixture of substances,the BOD is used as a measure of the concentration, or strength, of the wastewater. The test for BOD involves placing an aliquot of wastewater in a closed container and measuring the changes in oxygen levels that occur over time. Depending on the strength of the wastewater, full oxidation of the biodegradable material could take several weeks. Since it is impractical to measure the total, or ultimate, BOD, five days of oxygen consumption has been adopted by the wastewater treatment industry as a standard. Five days was chosen as it is the maximum time needed for sewage flow to reach the sea from any point in England, where modern wastewater treatment originated. The BOD measured over a period of five days is symbolized as BOD_5.

Since microorganisms inhabit domestic wastewaters, and are actually cultivated in a wastewater treatment plant, the concern arises that pathogenic organisms may be spread by the discharge of wastewater treatment plant effluent into surface waters. Disinfection is intended to kill the microorganisms present in the treatment plant effluent. Tests have been developed to detect if microorganisms are present and insure that disinfection has been effective. Rather than testing for the presence of pathogenic organisms, which would be dangerous for laboratory personnel, a substitute organism, *Escherichia coli*, has been chosen by the industry as a reasonable indicator of the possible presence of fecal matter and pathogenic organisms of human origin. *E. coli* is a particularly good indicator organism because it is a typical resident of the human intestinal tract and it is generally more resistant to disinfection than pathogenic organisms. Thus, destroying *E. coli* insures that harmful organisms are also destroyed.

Figure 2-2 depicts the BCUA wastewater treatment facility. The individual unit processes are listed in Table 2-2. The unit processes employed by the BCUA to perform the wastewater treatment steps of settling, biodegradation and disinfection are described in detail below.

2.3.1 Screening

The three main collection system trunk sewers merge at the wastewater treatment plant in Little Ferry in a 40 foot deep chamber. Before further processing, the wastewater entering the plant must be screened to remove rags, glass, rocks, and other large debris. Screening is performed in two separate screening chambers that may be operated independently. The screens consist of vertical steel bars spaced to catch debris of a certain size. Mechanized rakes continuously scrape the screens to remove the debris and deposit the material into hoppers.



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BERGEN COUNTY UTILITIES AUTHORITY
WATER POLLUTION CONTROL DIVISION
TABLE 2-2
TREATMENT PLANT PROCESSES

			YEAR 2002 FLOW OR LOADING CONDITION			
PROCESS	DESCRIPTION	OPERATING PARAMETERS	DESIGN AVG.	PEAK MONTH	MAX. TIME	
		Influent Flow, mgd	72	109	190 or	312
		Treated Flow, mgd	72	109	190	180
		Influent SS, mg/1	186	161	220	130
		Influent BOD, mg/1	216	178	170	105
		Effluent SS, mg/1	28	25	75	75
		Effluent BOD, mg/1	30	27	75	75
1 - Screening Facilities	Four - 5' Wide Mechanical Front-Cleaned Bar Screens	Screens Operating	2	2	5	
	Two - 5' Wide Mechanical Back-Cleaned Bar Screens	Velocity Through Screens, fps	1.2	1.4	1.6	
	One - 12" Wide Manual Cleaned Bar Screen					
2 - Sewage Pumps	Building No. 1: 1 - 10/20 mgd (2 speeds)	Pumps Operating Flow, mgd	1	2	6	
	3 - 15/30 mgd		30	45	190	
	3 - 40 mgd					
	Total Capacity: 230 mgd					
	Dependable Capacity 190 mdg (1)					
	Building No. 2: 2 - 10/30 mdg (5 speeds)	Pumps Operating Flow, mgd	2	2	3	
	1 - 40 mdg		42	64	122	
	2 - 50 mgd					
	Total Capacity: 200 mgd					
	Dependable Capacity 150 mdg (1)					
3 - Bypass Structure	One - 4'-3" Square Steel Conduit	Bypass Storm Flow Above 190 mgd	0	0	122	
4 - Grit Removal Facilities	One - 35' Diameter @ 50 mgd	Collectors Operating	4	4	4	
	One - 45' Diameter @ 75 mgd	Removal of Grit Coarser than				
	One - 40' Diameter @ 62.5 mgd	0.2 mm at peak flow				
	*One - 40' Diameter @ 62.5 mgd (new)					
	Grit Building No. 1 (for Collector No. 1)					
	One - Grit Washer	Washer Operating	1	1	1	
	One - Pneumatic Conveyor					
	Grit Building No. 2					
	Two - 24" Grit Washers	Washers Operating	1	1	1	
5 - Flow Meters (at outfall)	Three - Parshall Flumes, 7'-0" Throat Width	Measured Flow, mgd	72	109	190	
	*One - Parshall Flume, 7'-0" Throat Width (new)					

BERGEN COUNTY UTILITIES AUTHORITY
WATER POLLUTION CONTROL DIVISION
TABLE 2-2
TREATMENT PLANT PROCESSES

PROCESS	DESCRIPTION	OPERATING PARAMETERS	YEAR 2002 FLOW OR LOADING CONDITION DESIGN AVG.	PEAK MONTH	MAX. TIME
6 - Primary Settling Tanks	8 Tanks (16 Bays) 33' Wide x 100' Long x 9.5' Deep 4 Tanks (8 Bays) 29' Wide x 115' Long x 9.5' Deep *4 Tanks (8 Bays) 29' Wide x 115' Long x 9.5' Deep (new) Total Surface Area: 52,980 sq. ft.	Surface Settling Rate, gpd/sf Weir Loading, gpd/lf Detention Time, hrs Solids Removal, lbs/day	1,360 34,060 1.3 67,000	2,050 51,560 0.8 51,000	3,490 89,900 0.5 70,000
7 - Air Blowers	Four - Motor Driven blowers @ 45,000 scfm each	Blowers operating Air Available, scfm scf air/lb BOD applied (2)	2 90,000 1,120	2 90,000 700	3 135,000 570
8 - Standby Generators	Four Turbine Driven Generators rated: 1 - 900 kw 3 - 2500 kw each	Standby Power Available, kw	8,400	8,400	8,400
9 - Aeration Tanks	Ten Tanks 31' Wide x 300' Long x 15' Deep *Three Tanks 31' Wide x 300' Long x 15' Deep (new) Total Volume 1,813,500 cf	Loading, lbs BOD Applied/day/100 cf (less recycle) Return Sludge Detention Time, hrs, minimum (3) Mixed Liquor Detention Time, hrs (3) Sludge Age, days	50 8 1.7 8	78 6 1.2 4	157 6 0.7 4
10 - Secondary Settling Tanks	12 Tanks (24 Bays) 37' Wide x 170' Long x 12' Deep *Four Tanks (8 Bays) 37' Wide x 170' Long x 12' Deep (new) Total Area 100,650 sf	Surface Settling Rate, gpd/sf Weir Loading, gpd/lf Detention Time, hrs Solids Removal, lbs/day	780 10,700 2.8 31,400	1150 15,800 1.9 89,900	1950 26,800 1.2 114,000
11 - Chlorinators	Five Chlorinators, Automatic Proportioned Feed *One Chlorinator, Automatic Proportioned Feed (new) 0 to 6,000 lbs/day Four Chlorine Evaporators 8,000 lbs/day each	Chlorination Capacity, ppm @ 16,000 ppd	26.6	17.6	10.5
12 - Chlorine Contact Tanks	Three Tanks 36' Wide x 150' Long x 10' Deep *One Tank 36' Wide x 150' Long x 10' Deep (new) Total Volume: 216,000 cf	Detention Time, min. (4)	42	28	20

BERGEN COUNTY UTILITIES AUTHORITY
WATER POLLUTION CONTROL DIVISION
TABLE 2-2
TREATMENT PLANT PROCESSES

PROCESS	DESCRIPTION		OPERATING PARAMETERS	YEAR 2002 FLOW OR LOADING CONDITION DESIGN AVG.	PEAK MONTH	MAX. TIME
13 - Outfall	Three - 72" Outfall Sewer with Foam Traps *One - 72" Outfall Sewer with Foam Trap (new)		Velocity, fps	2.0	1.5	2.5
14 - Primary Sludge Pumping Stations	Three Stations with two - 400 gpm Torque Flow Pumps each *One Station with two - 400 gpm Torque Flow Pumps (new)		Pumps operating at each station Sludge to Thickeners, mgd	1 2.3	1 2.3	1 2.3
15 - Scum Facilities (5)	Two Scum Heating Tanks 7'-6" Wide x 14' Long x 6'-9" Deep Total Volume: 1,420 cf Two Pneumatic Ejectors			Intermittent Feed to Digester		
16 - Secondary Sludge Pumping Stations	Station No. 1:	Four - 2000 gpm. Return Sludge Pumps (1 Varidrive) Three - 200 to 425 gpm. Excess Sludge Pumps (Varidrive) Two - 500 gpm Spray Water Pumps Three - 550 gpm Clarified Effluent Pumps	Total all Stations: Return Sludge, mgd Excess Sludge, mgd Elutriant, mgd Spray Water, mgd Clarified Effluent, mgd	 16 0.8 6.5 6.1 1.0	 20.5 1.5 5.8 6.1 1.0	 20.5 1.8 5.5 6.1 1.0
	Station No. 2:	Four - 1300 to 2,000 gpm. Return Sludge Pumps (Each Two Speed) Three - 3,000 gpm. Elutriant Pumps (Each Two Speed) Two - 200 gpm. Excess Sludge Pumps (Varidrive)				
	Station No. 3:	Four - 900 to 2,000 gpm. Return Sludge Pumps (Each Two Speed) Two - 550 to 700 gpm. Excess Sludge Pumps (Each Two Speed) Two - 1300 gpm Spray Water Pumps Three - 700 gpm Clarified Effluent Pumps (with 7500 gallon Hydro-Pneumatic Tank)				
	*Station No. 4: (new)	Four - 900 to 2,000 gpm. Return Sludge Pumps (Each Two Speed) Two - 200 to 425 gpm. Excess Sludge Pumps (Varispeed) Two - 1300 gpm Spray Water Pumps				

BERGEN COUNTY UTILITIES AUTHORITY
WATER POLLUTION CONTROL DIVISION
TABLE 2-2
TREATMENT PLANT PROCESSES

PROCESS	DESCRIPTION	OPERATING PARAMETERS	YEAR 2002 FLOW OR LOADING CONDITION DESIGN AVG.	PEAK MONTH	MAX. TIME
17 - Sludge Thickeners	Four - 65' Diameter x 10' SWD Total Area: 13,260 sf Two - 2' Wide Mechanical Front Cleaned Bar Screen Three Degritters Four Surface Skimmers Two Thickening Centrifuges	Total Solids, lbs/day Solids Loading, lbs/sf/day Surface Settling Rate, gpd/sf/day		169,200 12.8 600 to 800	
18 - Thickened Sludge Pumping Station	Four Extra Heavy Duty Sludge Pumps	6% Sludge to Digesters, gpm		240	
19 - Sludge Digesters	Four Digesters with Floating Covers and Gas Recirculation East 80' Diameter x 29.5 SWD Total Volume: 643,000 cf One - 210 pgm Triplex Plunger Sludge Transfer Pump Three - 150 gpm Duplex Plunger Digested Sludge Pumps	Detention Time, days Volatile Solids Loading, lbs/day/cf Volatile Solids Reduction Digester Sludge Temperature Digested Sludge to Storage tanks, gpm		14 0.19 50% 90 to 100 degrees F 240	
20 - Sludge Storage Facilities	Two Tanks 100' Diameter x 17 SWD Total Volume: 334,000 cf Two 400 gpm Sludge Pumps to SDF 5 Days per week	Storage Time, days Feed Rate, gpm		7.37 329	
21 - Sludge Dewatering Facilities	Potassium Permanganate Batching/Addition, One System	Batch concentration, % TS Batch Rate, lbs/hr (max.) Feed Rate, gpm Dosage, ppm		3.00 60 2 180	
	Ferric Chloride Addition, One System	Concentration, % TS Feed Rate, gpm Dosage, ppm		28 1.5 1250	
	Polymer Batching, Two Systems Each	Batch concentration, % TS Batch Rate, lbs/hr. (max.)		0.5 45	
	Sludge Feed to Centrifuge, Four Pumps Each	Feed Concentration, % TS Feed Rate, gpm		3 165	

TABLE 2-2
TREATMENT PLANT PROCESSES

PROCESS	DESCRIPTION	OPERATING PARAMETERS	YEAR 2002 FLOW OR LOADING CONDITION DESIGN AVG.	PEAK MONTH	MAX. TIME
21 - Sludge Dewatering Facilities (cont'd)	Polymer Feed to Centrifuge Four Pumps Each	Feed Concentration, % TS		0.5	
		Feed Rate, gpm		8.4	
		Polymer Dosage, lb/DT		17	
	Dewatering Centrifuges, Three Each	Solids Loading, lbs/hr		2476	
		Capture, %		90	
		Solids Out, % TS		23	
	Cake Pumps, Three Each	Cake Concentration, % TS		23	
		Pump output ,gpm		19.4	
22 - Chemical Stabilization Facilities	Plow Blenders, Two Each	Sludge Feed Rate, WT/hr ea.		4.85	
	Lime Feeders, Two Each	Lime Feed Rate, lbs/hr ea.		3342.6	
	Lime Day Tank, Two Each	Lime Capacity, ft^3 ea.		100	
	Lime Storage Silos, Three Each	Lime Capacity, ft^3 ea.		2500	
	Alkaline Storage Silos, Three Each	Alkaline Material Capacity, ft^3 ea.		8200	
	Loading Conveyor, One Each	Beneficial Use Product, lbs/hr		12294.6	
		Ammonia Loading, lbs/hr		69	
		Sulfuric Acid Feed Rate, gph		14.06	

Notes:

1. Design Values at Average Flow:

	Influent	Effluent
BOD_5	250 ppm	25 ppm
S.S.	300 ppm	30 ppm

2. Capacity for 100 mgd Design Flow.
3. Largest Pump in each Pump Building out of service.
4. Does not include Thickener Overflow at about 10 to 14% of Design Flow.
5. Includes 15,000 cfm for channels and other uses.
6. Does not include Return Sludge at 25% of Design Flow.
7. Includes Detention Time in Outfall Facilities.

The screenings are then disposed of as a solid waste. The quantity of screenings increases dramatically during wet weather induced high flows.

2.3.2 Pumping

After the influent passes through the screens, the flow enters two pumping stations which lift the wastewater from the screening chamber to approximately 10 feet above ground level so that it may flow through the treatment process by gravity. The pumps in each pumping station are separated from the wet wells so that maintenance can be performed without removing the pumps. The electric motors which power the pumps are at ground level to prevent the possibility of flooding. The two pumping stations were constructed separately. The older station has seven pumps with a combined capacity of 230 mgd and the newer station has five pumps with a combined capacity of 200 mgd. The treatment plant can assimilate a maximum flow of approximately 150 mgd before bypassing must be initiated to protect the treatment process. If too much flow is pumped into the plant, treatment becomes inefficient and the process may not recover for several days.

2.3.3 Grit Removal

After the wastewater is pumped to 10 feet above ground level, it flows into a discharge channel that leads to the grit collector. Grit consists of sandy materials and other particulates that readily settle from the wastewater. Although some grit may be discharged to the sewer system by users, most grit is washed into the system along with groundwater infiltration. Since grit is inorganic, it cannot be removed in the biological treatment processes. If it is not removed prior to biological treatment, it accumulates in the process units, particularly the sludge digesters, and tends to cause excessive wear on the equipment. The grit is allowed to settle in a grit tank by slowing the velocity of the wastewater flow to approximately one foot per second. The inorganic grit settles at this velocity, but the organic material requiring further treatment does not. The grit is removed from the tanks and washed to remove residual organic material. As with screenings, the grit is disposed of as a solid waste.

2.3.4 Primary Settling

The treatment performed prior to this step of the process is intended to remove materials that could damage equipment and impair the downstream processes. Primary settling represents the first step of treatment intended to abate water pollution. Primary settling is merely a physical separation of solids from the wastewater. After grit removal, the wastewater flows into the primary settling tanks where the flow velocity is further reduced and the suspended material is allowed to settle to the bottom of the tanks. Approximately 50% of the suspended solids and 25% of the BOD are removed in this unit process. The settled material, referred to as primary sludge, is pushed by automatic sludge collection equipment into a hopper from which the sludge is pumped to the sludge thickeners. The treatment of this sludge is discussed separately. As part of primary treatment, floatable materials such as oil and grease that rise to the surface of the tanks are skimmed and discharged to the anaerobic sludge digesters.

2.3.5 Secondary Treatment

Because of the high BOD loads that remain in the wastewater following primary treatment, further treatment must be provided before the effluent may be discharged to the Hackensack River. The BCUA employs a biological treatment system known as the activated sludge process to achieve secondary treatment. During this process, the wastewater flows into an aerated and agitated tank containing a complex mixture of bacteria, fungi, protozoans, and other microorganisms which are referred to collectively as the biomass. The dissolved and suspended organic matter in the wastewater serves as a food source for the biomass which the organisms use to grow and reproduce.

Sufficient air must be provided to supply the biomass with the oxygen necessary for respiration. If too little air is introduced into the aeration tanks, the biomass will use anaerobic respiration to metabolize the organic matter, producing foul odors and poor effluent quality. The BCUA introduces air into the process tanks using four large blowers. Each blower is driven by a 2,000 horsepower electric motor with the capacity to provide 45,000 cubic feet of air per minute. These blowers represent the single largest energy requirement in the treatment plant.

The BCUA uses a variation of the activated sludge process known as contact stabilization. In the first step of this process, the wastewater is brought into contact with the biomass for a short period of time, in which the biomass absorbs the soluble BOD. The biomass is then settled and introduced into a stabilization tank where it is aerated for a longer period of time. In this step, the organic material is fully oxidized and the volume of the biomass increases.

2.3.6 Final or Secondary Settling

After the wastewater and biomass have been aerated for a sufficient period to allow the soluble BOD to be incorporated into the cells of the biomass, the mixture flows to the final, or secondary settling tanks. Since these tanks are not aerated or agitated, the biomass is allowed to settle. The remaining effluent, which by this point in the process appears quite clear, is ready to be chlorinated and discharged to the Hackensack River. The settled biomass is either reintroduced into a contact tank to serve as the inoculum for the process, or is wasted. Wasting the biomass, which is now designated as secondary sludge, refers to the removal of this material from the treatment process for final disposal. The wasted secondary sludge is pumped to the sludge thickeners for treatment. The full sludge treatment process is described separately.

2.3.7 Disinfection

After final settling, the supernatant from the secondary settling tanks flows into the chlorine contact tanks for disinfection. Disinfection, whether by chlorination or other means, is intended to kill or inactivate the pathogenic bacteria, viruses and protozoan cysts commonly found in wastewater. Disinfection is the critical step necessary to insure that waterborne diseases are not spread through the discharge of treated sewage.

The BCUA uses liquid chlorine to disinfect the treatment plant effluent. The liquid chlorine is evaporated to a gas, mixed with water, and discharged into the chlorine contact tanks in an amount proportional to the wastewater flow. The wastewater flow rate through the chlorine contact tanks is slow to allow the chlorine sufficient time to inactivate the microorganisms. The number of coliform bacteria remaining in the wastewater after chlorination is used as a measure of the effectiveness of disinfection. The BCUA also measures the chlorine residual in the wastewater discharged from the chlorine contact tanks. Chlorine residual, which is the amount of free chlorine that remains in the wastewater after chlorination, allows the disinfection process to continue even after the effluent is discharged from the chlorine contact tanks.

Chlorine is a highly poisonous gas that requires special handling. The BCUA has expended significant resources on its chlorine safety program. This program is discussed in Section 3.6.1 of this report.

2.3.8 Flow Measurement

Just prior to discharge, the flow is measured by four Parshall flumes. These flumes also provide the chlorination equipment with the data necessary to proportion the amount of the chlorine that is added to the chlorine contact tanks.

2.3.9 Final Discharge

At this point in the process, the wastewater has received adequate treatment to allow discharge to the Hackensack River. The BCUA is issued a New Jersey Pollutant Discharge Elimination System (NJPDES) permit by the New Jersey Department of Environmental Protection (NJDEP) to control the quality of the effluent discharged to this water body. Compliance with the NJPDES permit is of paramount importance since violations of permit limitations are subject to fines and penalties.

2.4 Sludge Treatment and Disposal

Sludge refers to the settled solids accumulated and separated from the liquid treatment process during both primary and secondary sedimentation. Raw sludge is unstable, putrescible and contains pathogenic organisms. Furthermore, settled sludge actually has a solids content of only 2 - 4%. Therefore, sludge requires extensive treatment before it can be safely disposed. The proper treatment and disposal of sludge is as important a part of the BCUA operation as the wastewater treatment process.

Two types of sludge are produced as byproducts of the wastewater treatment process. These sludges have different characteristics which can affect the sludge treatment process. Primary sludge, the sludge removed from the primary sedimentation tanks, contains high concentrations of organic matter. Although microorganisms inhabit primary sludge, most of the primary sludge consists of non-living matter. Secondary sludge, the sludge removed from the final settling tanks, consists mostly of living microorganisms that have flourished on the consumption of dissolved organic matter during secondary treatment of the wastewater.

A brief description of each unit process utilized for sludge treatment is presented below.

2.4.1 Sludge Thickening

Untreated sludge is a suspension of solids in water. One of the primary goals of sludge treatment is the further separation of solids from water to make treatment and disposal of the residuals more effective and efficient. Sludge thickening to increase the solids content of the sludge is the first step of the sludge treatment process.

The BCUA utilizes four gravity thickeners and two thickening centrifuges to thicken sludge. The gravity thickening process consists of pumping both primary and secondary sludge into a gravity thickening tank where the sludge is mixed and agitated gently by a rotating mechanism. The solids tend to settle to the bottom of the tank where they are pumped into the anaerobic digesters. The thickening tank supernatant is pumped to the headworks of the treatment plant for treatment.

The thickening centrifuges are used primarily to thicken wasted secondary sludge. Secondary sludge is more difficult to thicken than primary sludge, especially during warm weather when the density of the secondary sludge is reduced. The centrifuges add thickening capacity during these critical periods.

Sludge thickening, whether by gravity or centrifugation, relies on the addition of polymer to aid the process. Polymers act as flocculating agents, causing the particles of sludge to stick together and form larger particles, or flocs. The flocs are heavier than the smaller particles and settle more readily, thereby improving the efficiency of the sludge thickening process.

2.4.2 Anaerobic Digestion

Thickened sludge has a solids content of approximately 6% solids. While thickening increases the solids concentration of the sludge, the material still contains pathogens and putrescible organic matter. Anaerobic digestion is a means of reducing both the pathogen population and the volatile organic content of the sludge, thereby making the material more stable and easy to manage during ultimate disposal.

Thickened sludge is pumped from both the gravity thickeners and thickening centrifuges into the anaerobic digesters. The BCUA operates five anaerobic digesters. During the digestion process, the sludge becomes the food source for anaerobic bacteria, which in the absence of oxygen consume the organic material in the sludge and produce methane gas as a byproduct of respiration. The methane gas rises to the surface of the tanks where it is collected from under the digester covers and used as an energy source for the four boilers which provide the heat for the entire wastewater treatment facility. The microorganisms, by releasing methane gas, reduce the volatile organic content of the sludge by approximately 50 - 60%.

The anaerobic digestion process must occur under carefully controlled conditions. The temperature must be maintained between 95 to 100 degrees Fahrenheit. This temperature range is the optimum temperature for the anaerobic bacteria that feed on the sludge, but tends to inactivate the pathogens in the sludge, thereby resulting in significant pathogen reduction. Some methane gas is recirculated through the tanks to keep the sludge completely mixed and in contact with the anaerobic bacteria. Other parameters such as the pH and ammonia concentration in the tanks must also be carefully monitored. Since the process depends on the absence of oxygen, the digester covers are designed to float on the surface of the sludge, creating an airtight seal around the edge of the cover. The anaerobic sludge digestion process requires a holding time of 12 to 16 days.

The anaerobic digestion process produces a sludge that once again has a solids content of approximately 3%. So much methane is produced during anaerobic digestion that the mass of the material is reduced considerably, thereby reducing the solids concentration. At this stage in the sludge treatment process, the material is relatively stable and free of pathogens. Prior to 1991, the BCUA disposed of sludge in the ocean. At that time, anaerobic digestion was the final step of the sludge treatment process. More recently, the BCUA has been required to implement a land-based sludge disposal program, which requires additional treatment of sludge.

2.4.3 Dewatering

After anaerobic digestion, the digested sludge is pumped into the sludge holding tanks adjacent to the Sludge Dewatering Facility. Originally, these tanks were constructed to store digested sludge before loading it onto barges for ocean disposal. Today, these tanks are used to store digested sludge prior to dewatering.

The Sludge Dewatering Facility, in operation since 1993, houses three dewatering centrifuges designed to dewater digested sludge from approximately 3% solids to 22% solids. Achieving a solids content of 22% requires the addition of polymer to act as a flocculating agent. Ferric chloride is added to the process to prevent the formation of struvite, a mineral deposit that has the tendency to form on the equipment during centrifugation of sludge. Foul odors are controlled by the addition of potassium permanganate, which prevents the formation of hydrogen sulfide, the compound responsible for the easily recognized rotten egg smell. The centrate produced by centrifugation is directed to the headworks of the treatment plant for treatment.

Prior to dewatering, the sludge has a density and consistency similar to water. After dewatering, the sludge has the consistency of a thick mud, referred to as sludge cake. Moving the material to the next phase of treatment requires the use of pumps developed by the concrete industry. Dewatered sludge cake is pumped to the Chemical Stabilization Facility for alkaline stabilization. If necessary, the sludge cake can also be loaded directly onto trucks for final disposal.

2.4.4 Chemical Stabilization

Since the federal ban on ocean disposal of sewage sludge in 1991, the BCUA has implemented a land-based sludge management and disposal program. The BCUA program has depended on the disposal of sludge in municipal solid waste landfills. Dewatered sludge cake is of sufficient stability to be safely transported and disposed of by commingling with municipal solid waste. However, disposal of sludge in a landfill is costly and depends on the availability of landfill space in other states. The BCUA has, therefore, opted for an additional treatment step to the sludge treatment process to make the material acceptable for beneficial reuse as a fertilizer or soil amendment. This additional treatment step is referred to as chemical stabilization and is performed in the Chemical Stabilization Facility.

Dewatered sludge cake is pumped into the Chemical Stabilization Facility where it is immediately mixed with quicklime (CaO) in a plow blender. The sludge and lime are mixed for less than a minute, during which time the lime reacts with the water in the sludge raising the temperature to 180 degrees Fahrenheit and the pH to 13 units. The high temperature and pH effectively destroy the pathogens remaining in the sludge after digestion and dewatering, which makes the material safe for land application. The high temperature also results in additional evaporation of water which makes the material appear more like soil than sludge.

The process of alkaline stabilization tends to produce odors that must be captured by an air pollution device. Raising the pH of the material by lime addition causes ammonia in the sludge to be driven off as a gas. The ammonia creates foul odors and can result in irritation of the mucous membranes of workers that breathe in the vapors. To prevent the escape of these odors to the atmosphere, the Chemical Stabilization Facility contains an air scrubber which captures the vapors and washes them with sulfuric acid. The acid lowers the pH which causes the ammonia to redissolve into the spray water. The spray water flow is directed back to the headworks of the treatment plant for treatment.

2.4.5 Ultimate Disposal

After chemical stabilization is complete, the sludge product is loaded into trucks for transportation to a final disposal site. While municipal solid waste landfills are currently the final disposal locations, the BCUA sludge will soon be used as an intermediate soil cover material for a landfill in Pennsylvania. The BCUA is also pursuing the use of sludge product as a fertilizer. This new sludge management strategy is evidence of a change in philosophy regarding the acceptability of sludge as a recyclable product.

2.5 Support Systems

The operation of a wastewater treatment facility is complex. As such, there are a number of systems in place that provide necessary support to the operations.

2.5.1 Electrical

The BCUA receives its electric power from a 26,000 volt service supplied by Public Service Electric & Gas (PSE&G). The BCUA owns a substation which reduces the voltage to 4,160 volts prior to distribution throughout the plant. The larger motors in the treatment plant run on 4,160 volts. To accommodate the smaller motors and electric loads, a number of transformers are located throughout the facility to reduce the voltage to 480 or 120 volts. The BCUA also operates an emergency backup generating facility with three 2,500 kilowatt turbine generators that can produce sufficient power to maintain the plant operations in the event that the power from PSE&G is lost.

2.5.2 Heating

The BCUA utilizes the methane gas produced during the anaerobic sludge digestion process as a fuel source for its four boilers. The boilers, in turn, provide the heat for the wastewater treatment facility. Heating requirements include warming the anaerobic sludge digesters, which must be kept between 95 and 100 degrees Fahrenheit to support the biological activity. The boilers also provide normal building heating.

2.5.3 Laboratory

The biological processes of secondary wastewater treatment and anaerobic sludge digestion require constant monitoring to insure that effective treatment is provided. The necessary sampling and analyses to control the treatment plant processes are performed by the BCUA laboratory. The BOD, suspended solids and numerous other parameters are measured at various locations and reported to the plant operators, who use this data to make decisions about operating the facility. Much of this data is eventually reported to the NJDEP as part of the monthly Discharge Monitoring Report (DMR) required to demonstrate compliance with all permit requirements. The laboratory field crews collect samples from the 166 metering chambers located throughout the service area to measure the BOD and suspended solids. Approximately 2,000 samples are collected each year to calculate the user charges for the municipalities. The laboratory also samples more than 200 industries in Bergen County in support of the Industrial Pretreatment Program which controls the discharge of pollutants from industrial sources.

2.6 Other Projects

The BCUA must respond to the demands of both regulators and the public. The BCUA must expand and modernize its facilities to serve the ever-increasing population of Bergen County and insure that these increased wastewater loads do not jeopardize the ability of the treatment plant to produce a high quality and environmentally safe effluent. It is also the responsibility of the BCUA to accomplish its mission at the lowest cost possible. To this end, the BCUA has undertaken various projects to maintain and improve it systems.

2.6.1 Treatment Plant Expansion

Construction has been initiated to expand the capacity of the wastewater treatment plant from 94 mgd to 109 mgd to allow for increased population and industrial growth in Bergen County. This expansion, which is being constructed in multiple phases, is designed to serve the wastewater and sludge treatment needs of Bergen County for the next 25 years. Already completed and in service are four secondary settling tanks and one anaerobic sludge digester. The next phase of the expansion, which is currently under construction, includes the addition of four primary settling tanks, three secondary aeration tanks, and a sludge thickening building to house the two existing thickening centrifuges. The total cost of the expansion is approximately $42,000,000.

The treatment plant expansion project originally included the construction of a cogeneration facility to use methane from the anaerobic digesters to power certain plant operations. This part of the design has been eliminated as the BCUA has opted to take advantage of the PSE&G Standard Offer, described in Section 2.6.3. This program will defer approximately $5,000,000 in construction costs.

2.6.2 Ultraviolet Disinfection

The BCUA is studying the use of ultraviolet light as a disinfection medium. A pilot unit is scheduled to be tested in 1995 to evaluate the effectiveness of this technology on the BCUA effluent. Although the overall cost of ultraviolet disinfection is higher than the cost of chlorination, it is much safer to use and would relieve the BCUA from the burdens of the Toxic Catastrophe Prevention Act.

2.6.3 PSE&G Standard Offer

The PSE&G Standard Offer is a program wherein reimbursements are offered to electric users for conservation of electric energy. The BCUA has agreed to take advantage of this incentive program. Currently, the blowers which provide the air for the secondary aeration process are powered by 2,000 horsepower electric motors. These blowers represent the largest energy requirement for the BCUA treatment plant. The BCUA has initiated a project to replace one of the four existing electric blower motors with an internal combustion engine and install an additional blower and engine set. These engines can be powered by methane from the anaerobic sludge digesters or by natural gas purchased from PSE&G. The heat generated by the internal combustion engines will be used to heat the BCUA facilities in Little Ferry. The equipment costs approximately $5,000,000, but will result in a savings of $1,000,000 per year in electric costs.

2.6.4 PSE&G Effluent Reuse Project

PSE&G has commenced the construction of a repowering project for their Bergen Generating Station in Ridgefield to allow for greater generation of energy with less environmental degradation. Part of this project involves a modification of the PSE&G cooling facilities. Currently, PSE&G obtains its cooling water for the Bergen Generating Station from the Hackensack River and returns the water to the Hackensack River after use at an elevated temperature. The elevated temperature tends to cause dissolved oxygen reductions in the Hackensack River during the summer months, which can damage aquatic life and cause undesirable aesthetic problems. With the cooperation of the BCUA, PSE&G has devised a program to use the BCUA treatment plant effluent as cooling water for the station. Rather than discharging the spent cooling water to the Hackensack River, the cooling water will be discharged to the BCUA for treatment, thereby eliminating the heat effects of cooling water discharge on the Hackensack River. PSE&G will purchase the effluent for $75,000 per year and will be required to obtain an Industrial Wastewater Discharge Permit from the BCUA's Industrial Waste Control Department which administers the Industrial Pretreatment Program.

2.6.5 Telemetering

The BCUA operates and maintains 166 metering sites throughout the collection system. Each meter has a seven day chart which must be changed manually at least once per week. Technology is now available whereby the flow data recorded on the charts can be stored electronically and transmitted to the BCUA facility in Little Ferry via telephone lines, thus eliminating the need to manually change charts. Telemetering equipment requires less maintenance than manual chart recorders and results in a more accurate calculation of flows. Storing the data on computer allows more versatility of use, which will be an advantage during upcoming studies on infiltration and inflow reduction. Several vendors of telemetering systems have demonstrated their equipment and the BCUA will be choosing a manufacturer during 1995. Preliminary estimates indicate that the cost to the BCUA will be approximately $2,000,000.

2.6.6 Overflow Mitigation

The BCUA is required under the terms of an Administrative Consent Order (ACO) to eliminate the untreated wastewater overflows in the collection system and at the treatment plant in Little Ferry. A detailed description of overflow mitigation issues is provided in Section 3.5.2. To comply with the ACO, the BCUA has recently initiated the rehabilitation of the Pink Street Pumping Station in Hackensack, which will eliminate the wastewater overflow at this location. The cost of the construction is approximately $1,400,000. The BCUA engineering staff is also designing the rehabilitation of a metering chamber in Englewood to reduce another wastewater overflow at an estimated construction cost of $460,000. The remaining overflows, particularly the overflow located at the treatment plant in Little Ferry, cannot be mitigated without extensive reduction of infiltration and inflow in the collection system. The cost to fully satisfy the terms of the ACO may approach $50,000,000.

2.6.7 Northern Valley Forcemain

The Northern Valley Forcemain conveys all wastewater flow from the Northern Valley region of Bergen County to the Hackensack Valley Trunk Sewer. The line circumnavigates the Oradell Reservoir, which provides the potable water supply for Bergen County. Over the years, the line has been subject to corrosion caused by hydrogen sulfide, which led to the collapse of the line in 1987. The collapsed line was replaced, but other sections of the line are believed to be vulnerable to corrosion. Construction has commenced to parallel a portion of the existing line with plastic line, which is more resistant to corrosion. The cost to parallel this section of the line is approximately $692,000. Other sections will be rehabilitated during 1996.

3.0 Regulatory Issues

3.1 Early Regulations

Prior to the enactment of state and federal water pollution control laws, local governments independently constructed sanitary sewer systems and wastewater treatment plants as needed to prevent public health problems. Many municipalities in Bergen County built wastewater treatment facilities during the 1920s and 1930s as increasing development densities precluded the continued effective use of septic systems. By 1935, twenty-four municipalities had constructed wastewater treatment plants within the present BCUA service area. Since most of these facilities were designed to provide only primary treatment, the Hackensack River and Overpeck Creek remained highly polluted waterways.

In 1936, the New Jersey Department of Health mandated that wastewater treatment plants discharging to the Hackensack River provide at least a secondary level of treatment. Subsequent directives and court orders necessitated that Bergen County implement corrective actions. The Bergen County Board of Freeholders established the Bergen County Sewerage Authority in 1947 to construct and operate a wastewater treatment plant designed to abate the pollution caused by the discharge of inadequately treated wastewater from municipal facilities. By 1951, the BCUA had constructed a 20 mgd regional secondary treatment plant in Little Ferry, and the trunk sewers needed to extend service to the southeastern portion of Bergen County. Subsequent expansions constructed during the next forty years increased the treatment capacity of the plant from 20 mgd to 94 mgd and provided treatment to the majority of municipalities in Bergen County.

Water pollution control has evolved from a local responsibility to a complex federally mandated program. The Water Pollution Control Act of 1948 represents the first attempt of the federal government to regulate the quality of surface waters. Water quality standards were developed for specific pollutants which described the amount of each pollutant that would be allowable within particular water bodies. While the Act established water quality standards for waters receiving discharge from point sources, it limited federal oversight to an advisory role and provided little enforcement power for the states. These early water quality standards were difficult to translate into specific discharge limitations for point sources. Additionally, these standards were limited to conventional pollutants, such as BOD and suspended solids, and in general, did not address toxic pollutants.

3.2 Federal Water Pollution Control Act of 1972

The uncontrolled discharge of pollutants from industrial, municipal and nonpoint sources has the potential to jeopardize human health and degrade the environment. That recognition led to the passage of the single most important law dealing with the quality of surface waters within the United States. The Federal Water Pollution Control Act of 1972 set a national objective of restoring and maintaining the physical, chemical and biological integrity of the waters of the United States. To achieve that objective, the Act set two goals:

1. Achieving a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water; and

2. Eliminating the discharge of pollutants.

The United States Environmental Protection Agency (USEPA) was established to provide federal oversight to the water pollution control program and to promulgate the regulations necessary to achieve the goals of the Act. The states were given the primary responsibility of implementing the USEPA water pollution control

programs and addressing local needs. The formal mechanism for controlling water pollution as outlined in the Act is the National Pollutant Discharge Elimination System (NPDES) permitting program.
Permits are required for any discharge of pollutants to surface water or groundwater. Discharging without a permit or exceeding permit limitations are considered permit violations, which are punishable by fines or, in some cases imprisonment. Many states, including New Jersey, have developed their own permitting programs and have been delegated the responsibility of issuing and enforcing permits by the USEPA. Hence, the BCUA has been issued a New Jersey Pollutant Discharge Elimination System (NJPDES) permit by the New Jersey Department of Environmental Protection (NJDEP) to regulate the pollutants discharged by the BCUA wastewater treatment plant. States must administer permitting programs according to the minimum requirements set forth by the USEPA, but may develop permit provisions that are more stringent than the USEPA minimum standards.

Under the NPDES permitting provisions of the Federal Water Pollution Control Act of 1972, two basic approaches exist for controlling pollutant discharges from municipal wastewater treatment facilities. Technology-based controls consist of uniform standards developed by the USEPA which are based on a complex determination of the effluent quality the current treatment technology can attain without taking into consideration the existing or desired use of the receiving water. The technology-based approach, as applied to wastewater treatment plants, mandates that a minimum of secondary treatment must be provided. The USEPA has defined secondary treatment for municipal wastewater as an effluent containing, on a 30-day average basis, a BOD_5 concentration not exceeding 30 mg/l, a TSS concentration not exceeding 30 mg/l and pH between 6.0 and 9.0 standards units. Not withstanding the concentration limits, the regulations also require a minimum of 85% removal of the BOD_5 and TSS entering the treatment plant. Minimum standards have also been established for pathogen control.

Since technology-based standards only specify the minimum treatment required, the Act also outlined a water quality-based approach to controlling water pollution. States were delegated the task of classifying all surface waters according to the desired use of each water body, such as potable water supply, recreation or ship navigation. Pollutant standards were developed for all waters which describe the amount of pollutant the water body can assimilate while still maintaining the desired use. If the desired use of the water body was not being achieved, dischargers would have to meet water quality-based NPDES permit limitations. While the Act set forth the basic approach to developing water quality-based limitations, the incorporation of these limits into NPDES permits was not easily achieved until these provisions were further strengthened in subsequent amendments to the Act.

3.2.1 NJPDES Permit

The NJPDES permit issued to the BCUA by the NJDEP controls the discharge of pollutants into the lower Hackensack River by establishing limitations for specific pollutants that the BCUA treatment plant must meet. These pollutant limitations include the technology-based standards mandated by the Federal Water Pollution Control Act of 1972. A list of the chemical-specific pollutant limitations included in the most recent issuance of the BCUA's NJPDES permit is included as Table 3-1. Permits are issued for a period of five years. The annual permit fee is $450,000.

Bergen County Utilities Authority
Water Pollution Control Division

Table 3-1

New Jersey Pollutant Discharge Elimination System Permit Limitations

Parameter	Limitation	
BOD_5	30 mg/l	Monthly Average
BOD_5	45 mg/l	Weekly Average
BOD_5	8550 kg/day	Monthly Average
BOD_5	12825 kg/day	Weekly Average
BOD_5	85 percent removal	Monthly Average
Suspended Solids	30 mg/l	Monthly Average
Suspended Solids	45 mg/l	Weekly Average
Suspended Solids	8550 kg/day	Monthly Average
Suspended Solids	12825 kg/day	Weekly Average
Suspended Solids	85 percent removal	Monthly Average
Settleable Solids	0	
Fecal Coliform	200 mpn	Monthly Average
Fecal Coliform	400 mpn	Weekly Average
Oil & Grease	10 mg/l	Monthly Average
Oil & Grease	15 mg/l	Any sample
Acute Bioassay	50% - 96 hour LC_{50}	
Chronic Bioassay		Report Only
Phenols	0.2 mg/l	Any Sample
Dissolved Oxygen		Report Only
Chlorine Residual		Report Only
Temperature		Report Only
pH	6 - 9 Standard Units	

Table 3-1 (Continued)

New Jersey Pollutant Discharge Elimination System Permit Limitations

Parameter	Limitation
Antimony	Report Only
Arsenic	Report Only
Beryllium	Report Only
Cadmium	Report Only
Chromium	Report Only
Copper	Report Only
Lead	Report Only
Mercury	Report Only
Nickel	Report Only
Selenium	Report Only
Silver	Report Only
Thallium	Report Only
Zinc	Report Only
Cyanide	Report Only
Volatiles	Report Only
Acid Compounds	Report Only
Base/Neutral Compounds	Report Only
Pesticides	Report Only

Compliance with NJPDES permit limitations is verified through submission by the BCUA of monthly Discharge Monitoring Reports (DMRs) and through annual inspections conducted by the NJDEP. The monthly DMR contains the results of laboratory analyses of the treatment plant influent and effluent for the permitted pollutants. In addition to numeric limitations, the NJPDES permit requires the BCUA to monitor for the presence of pollutants such as metals and organic compounds in both the influent and effluent and report these results in the monthly DMR.

The NJDEP uses the NJPDES permit as a tool to enforce compliance with new pollution control policies. In addition to numeric permit limitations, the permit may contain permit conditions which require a discharger to institute programs and perform studies that are consistent with state or federal water pollution control goals. For instance, the requirement that the BCUA perform a Toxicity Reduction Evaluation to investigate and mitigate effluent toxicity was a NJPDES permit condition. The BCUA is subject to fines and penalties for both discharges in excess of numeric permit limitations and failure to carry out permit conditions. Satisfying permit conditions can be as costly for a discharger as achieving compliance with a numeric discharge limitation.

The BCUA operates the treatment facility to meet the effluent quality specified by the NJPDES permit. Table 3-2 presents the BCUA's 1994 monthly average effluent concentrations of BOD_5 and TSS and the percent removals from the influent concentrations as reported to the NJDEP in monthly DMRs. Also

Bergen County Utilities Authority

Table 3-2

Discharge Monitoring Report Data
1994

Month	Flow (MGD)	Total Bypass (MG)	Effluent Total Suspended Solids			Effluent 5-Day Biochemical Oxygen Demand		
			Mass Loading (KG/D)	Concentration (MG/L)	Removal (%)	Mass Loading (KG/D)	Concentration (MG/L)	Removal (%)
January	80.187	65.700	4160	15	91.8	4402	15	91.6
February	84.078	0	6260	21	89.1	5908	20	88.6
March	112.146	44.050	10512*	26	85.6	11254*	28	82.1*
April	95.817	0	8849*	25	87.1	9148*	26	84.0*
May	83.453	0	5364	17	92.7	5468	17	90.6
June	75.682	0	4622	16	93.9	7276	26	87.2
July	73.655	0	3871	14	93.9	4726	17	90.1
August	73.439	0	3608	14	93.3	4822	18	89.1
September	63.920	0	4247	18	92.0	4847	20	88.8
October	62.094	0	3454	15	94.5	4164	18	90.8
November	64.496	0	4758	21	90.7	4018	17	88.8
December	72.365	0	5167	19	91.0	4463	17	89.0
Average	78.444	-	5406	18	91.3	5875	20	88.4
Limits		0	8550	30	85	8550	30	85

* Not in compliance with permit limitations

presented are the permit limitations for each parameter. A review of this data reveals that the technology-based pollutant limitations of 30 mg/l monthly average concentration for both BOD_5 and suspended solids are met consistently. The discharge also satisfies the requirement of 85% removal of both the influent BOD_5 and suspended solids concentrations on a monthly average basis. Given the magnitude of the fines and penalties issued by the NJDEP for permit violations, which may amount to hundreds of thousands of dollars, consistent compliance with the NJPDES permit is an important achievement for the BCUA.

Previously, the NJDEP had included a maximum flow rate of 75 mgd in the BCUA's NJPDES permit. The NJDEP based the flow limitation on the treatment plant capacity, and considered any flow that exceeded the capacity a permit violation, regardless of the level of treatment being provided. The high rates of infiltration and inflow in the collection system made this requirement difficult to meet, and it was subsequently removed from the permit through a permit modification issued in early 1995. While flow has been removed from the NJPDES permit as a limitation, the permit does contain mass loading limitations for BOD_5 and TSS based on a flow rate of 75 mgd.

The mass loading of a pollutant is calculated by multiplying the effluent concentration of the pollutant by the flow and a conversion factor to obtain the result in kilograms per day (kg/d). The BCUA's NJPDES permit contains mass loading limitations for BOD_5 and TSS of 8,550 kg/d based on the 75 mgd flow rate and the permitted effluent concentration of 30 mg/l. In March and April 1994 the BCUA's effluent mass loading for the two parameters exceeded the permitted mass loadings. This exceedance was the result of higher than normal flows caused by excessive wet weather induced infiltration and inflow during these months rather than poor treatment. In fact, the effluent concentrations remained below the permitted concentrations, and therefore, mass loading in excess of permit limitations may be attributed to the method in which the mass loading is calculated. While the treatment plant can provide effective treatment for a higher capacity than 75 mgd, the NJDEP has been reluctant to increase the permitted mass loadings until water quality studies being conducted under the auspices of the New York/New Jersey Harbor Estuary Program have been completed.

3.2.2 Federal Grant Program

Another important program established by the Federal Water Pollution Control Act of 1972 was the grant program administered by the USEPA. The Congress determined that many municipalities would face fiscal difficulties funding the expansion and upgrade of treatment plants, and therefore set aside funds for this purpose. The BCUA utilized federal grant money to upgrade the treatment plant during the 1970s. Conditions were attached to a number of grants which required the BCUA to address various issues such as infiltration/inflow and advanced wastewater treatment. These issues will be addressed in other sections of this report. Through the last few decades, the BCUA has utilized approximately $80,000,000 in federal grant funds.

Unfortunately, the federal grant funding which was available in the 1970s is no longer available today. While the treatment burdens placed on facilities such as the BCUA have become more numerous and complex, the federal and state funding available to implement required treatment modifications has been reduced significantly. The result is that the local municipalities must support the cost of future expansions or modifications required to achieve compliance with state and federal directives.

3.3 The Clean Water Act of 1977

The Federal Water Pollution Control Act of 1972 directed the USEPA to establish technology-based standards for publicly owned treatment works. It also required the USEPA to develop standards for industrial dischargers either discharging directly to surface waters or discharging into a wastewater treatment plant. The USEPA recognized that the introduction of certain materials into municipal wastewater treatment plants may interfere with the treatment process or pass through the treatment process and cause environmental damage. As part of the technology-based standards mandated by the Act, the USEPA developed uniform pretreatment standards for industry to provide a consistent approach across the nation to the control of pollutants from industrial sources.

The USEPA classified industry by category and developed treatment standards for each category based on the best practicable technology which was economically achievable by each particular industry as a whole. A procedure was also established whereby toxic pollutants discharged by certain polluting industries were identified and effluent limitations established regardless of the technology available to treat them. The effluent limitations and treatment standards developed for these categories of industries are referred to as the National Categorical Standards. Industries in a particular category are subject to the National Categorical Standards regardless of their location within the United States.

By 1977, it was apparent that the cumbersome procedure utilized to develop industrial technology-based standards was not working. The identification and categorization of industries was problematic because many industries did not conform to standard categories, or performed functions that overlapped many categories. The Act contained timetables for the USEPA to develop and promulgate effluent standards for each type of industry, but problems such as lack of funding and the political power of many industries prevented the USEPA from meeting these deadlines. Furthermore, the development of national standards did not address the local concerns of municipal treatment facilities accepting industrial discharges.

One provision of the Clean Water Act of 1977 directed the USEPA to strengthen the existing pretreatment requirements and to develop an approach which would give wastewater treatment plants the authority to regulate the materials discharged by industry. As a result, the USEPA developed a National Pretreatment Program and promulgated the General Pretreatment Regulations (40 CFR Part 403) which outlined the requirements for state and local pretreatment programs and established both general standards and categorical standards for industries discharging to wastewater treatment plants. The USEPA provided states with guidance on appropriate methods of overseeing the pretreatment program. Each state developed specific pretreatment program requirements and delegated the responsibility of administering these programs to local agencies, such as the BCUA.

The General Pretreatment Regulations contain minimum prohibitions which apply to all industrial or commercial dischargers to a wastewater treatment plant. These standards, which are referred to as Prohibitive Discharge Standards, are designed to protect the wastewater treatment plant and the collection system from harmful substances. The regulations prohibit the discharge of the following pollutants to a wastewater treatment plant:

- Pollutants that create a fire or explosion hazard in the wastewater treatment plant;
- Pollutants that cause corrosive structural damage;
- Solid or viscous pollutants in amounts that cause obstructions in sewers or interfere with the operation of the wastewater treatment plant;
- Pollutants at a flow rate and concentration known to cause or that may cause interference with the wastewater treatment plant; and
- Heat in amounts which will inhibit biological activity and cause interference at the wastewater treatment plant.

More importantly, the promulgation of the General Pretreatment Regulations gave wastewater treatment plants the authority to control the discharge of pollutants through the development of local pretreatment limitations. In instances where the National Categorical Standards or Prohibitive Discharge Standards do not provide sufficient protection from pollutants, local pretreatment limitations may be developed to address site-specific needs. The implementation of local pretreatment limitations is essential to achieving the objectives of the National Pretreatment Program.

In the administrative hierarchy that exists today, the USEPA is responsible for designing the overall goals of the National Pretreatment Program and overseeing the pretreatment programs in each state. In New Jersey, the NJDEP is responsible for either administering the federal pretreatment requirements or empowering a local agency to implement an individual pretreatment program according to federal and state requirements. In the case of the BCUA, the NJDEP determined in 1983 that the expertise and resources were available to develop a local pretreatment program. An Industrial Pretreatment Program manual was prepared and submitted to the NJDEP, and the BCUA program was approved in 1984. The BCUA's Industrial Pretreatment Program is described in detail in

Section 3.3.1 below.

Another important regulatory program that resulted from the passage of the Clean Water Act of 1977 was the establishment of comprehensive rules for the use and disposal of municipal sewage sludge. As enacted in 1972, the Act addressed sewage sludge only when the disposal of the material posed an immediate threat to navigable waters. In 1977, Congress recognized that the technology-based standards for municipal wastewater treatment plants had resulted in the generation of ever-growing amounts of sewage sludge. Proper management of this material became a concern for the regulatory community, and with the passage of the Clean Water Act of 1977, Congress directed the USEPA to develop guidelines for the safe use and disposal of sewage sludge.

The development of appropriate criteria for sludge use and disposal was enormously complex and required the USEPA to conduct extensive study. The USEPA addressed the risks to both human health and the environment from many pollutants in sewage sludge and many exposure pathways. As a result, the final promulgation of these regulations did not occur until 1993, at which time the USEPA adopted the 40 CFR Part 503 Standards for the Use or Disposal of Sewage Sludge. These regulations are vital to the development of the BCUA's future sludge management goals and are discussed in detail in Section 3.3.2 of this report.

3.3.1 Industrial Pretreatment Program

The BCUA is required to administrate and enforce an Industrial Pretreatment Program (IPP) to meet the requirements and goals of the National Pretreatment Program. The BCUA program must also conform to the requirements of the New Jersey Water Pollution Control Act as amended by the Clean Water Enforcement Act of 1990, which mandates certain program requirements that are more restrictive than the National Pretreatment Program. For instance, this legislation provides for the issuance of mandatory fines and penalties for violations of effluent limitations by industrial dischargers. The BCUA must administer and enforce an IPP as a condition of its NJPDES permit to discharge to the Hackensack River.

Since its inception in 1984, the IPP has been effective in protecting the BCUA wastewater treatment plant, the local community and the Hackensack River from the negative impacts of industrial discharges. The IPP protects the collection system and treatment facilities from corrosive and explosive chemicals. The biological treatment processes are protected from upset and interference caused by toxic pollutants or excessive oxygen demand. The IPP controls the discharge of pollutants, such as metals, which may pass through the treatment process untreated and cause environmental damage. The BCUA treatment plant workers are protected from pollutants which may jeopardize their health and safety. In recent years, sludge quality has become an important consideration for the BCUA and it is largely through the efforts of the IPP that the BCUA has achieved compliance with stringent sludge quality metals limitations for beneficial reuse.

The goal of the IPP is to impose only those additional regulations on industry required to achieve the following objectives:

- Protection of capital facilities;
- Protection of the collection system and treatment plant personnel;
- Protection of the community;

- Protection of the environment; and
- Beneficial use of treatment plant sludge.

Dischargers of industrial process wastewater to the BCUA treatment plant must adhere to the provisions of the IPP. These provisions are described in the Rules and Regulations for the Direct and Indirect Discharge of Wastewater to the Bergen County Utilities Authority Treatment Works (Rules and Regulations). In some cases, compliance with the effluent limitations imposed by the IPP requires an industrial user to significantly reduce the amount of pollutants in the industrial process wastewater through installation of pretreatment technology, pollution prevention, or other means, prior to discharging to the BCUA. More than 200 industries in the BCUA service area are issued Industrial Wastewater Discharge Permits which contain the specific requirements the industry must comply with, which include effluent limitations, monitoring and reporting requirements, and applicable penalties for non-compliance. Each industrial user is inspected and sampled by BCUA personnel at least once or twice per year, depending on the size, type and compliance status of the industry.

Industrial users discharging to the BCUA treatment works are subject to the Prohibitive Discharge Standards described in the General Pretreatment Regulations. Industries that are classified as categorical facilities, such as pharmaceutical companies or metal finishers, must comply with the technology-based National Categorical Standards promulgated by the USEPA for that industry. The BCUA regulates approximately 30 categorical industries through the IPP and enforces the categorical effluent limitations developed for each industry. Additionally, the BCUA has developed local pretreatment limitations for industrial users to address local needs. Industrial users must comply with local pretreatment limitations whether or not they are subject to the National Categorical Standards.

The local pretreatment limitations imposed on industrial users by the IPP were developed as part of the BCUA's program to exploit opportunities for beneficial use of sewage sludge. The practice of ocean disposal of sewage sludge was banned by the USEPA in 1991. As a result, the BCUA became a party to a Judicial Consent Decree (JCD) which mandated that the BCUA take steps to develop a land-based sludge management program, including development of local pretreatment limitations for metals to achieve compliance with beneficial use sludge quality criteria. The BCUA used recommended USEPA methods to evaluate the need for limitations for arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc and other pollutants of concern. Specific limitations were developed for cadmium and copper to be imposed on industrial users at the point of discharge because these parameters were found to be contaminating the BCUA's sludge. The limitations for cadmium and copper were adopted by the BCUA in 1992 and were subsequently incorporated into all Industrial Wastewater Discharge Permits.

The results of monthly sludge quality analyses for metals since 1990 are depicted in Figures 3-1 through 3-8. A linear regression analysis is also depicted on each figure, denoted as "Trend Line". A review of this sludge quality data reveals that the concentrations of cadmium and copper have been reduced significantly since the adoption of local pretreatment limitations for metals in 1992. In fact, the BCUA has achieved consistent compliance with the NJDEP Class "B" sludge quality criteria for land application of sludge as established by the NJDEP in the 1987 New Jersey State Sludge Management Plan, which

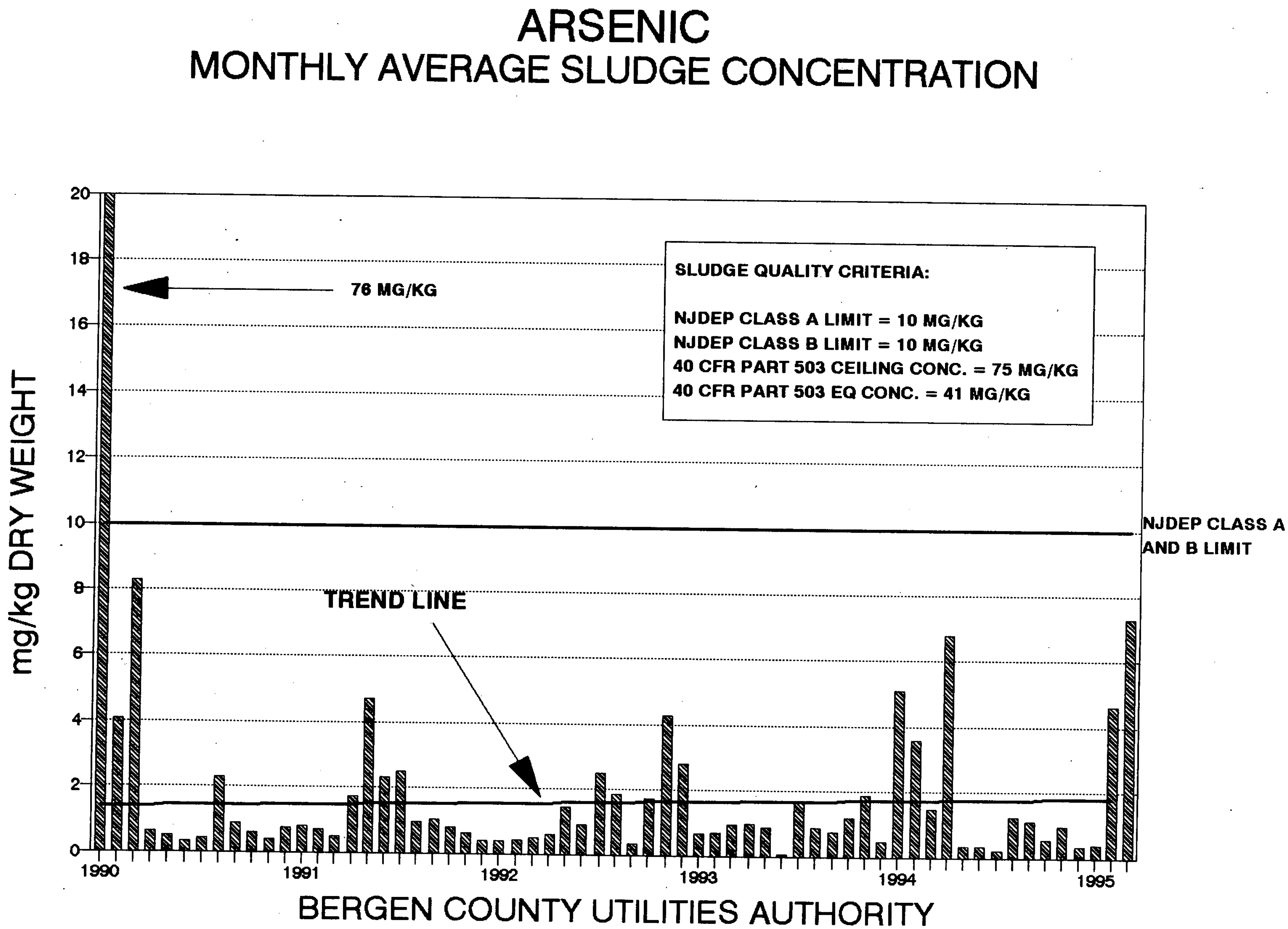
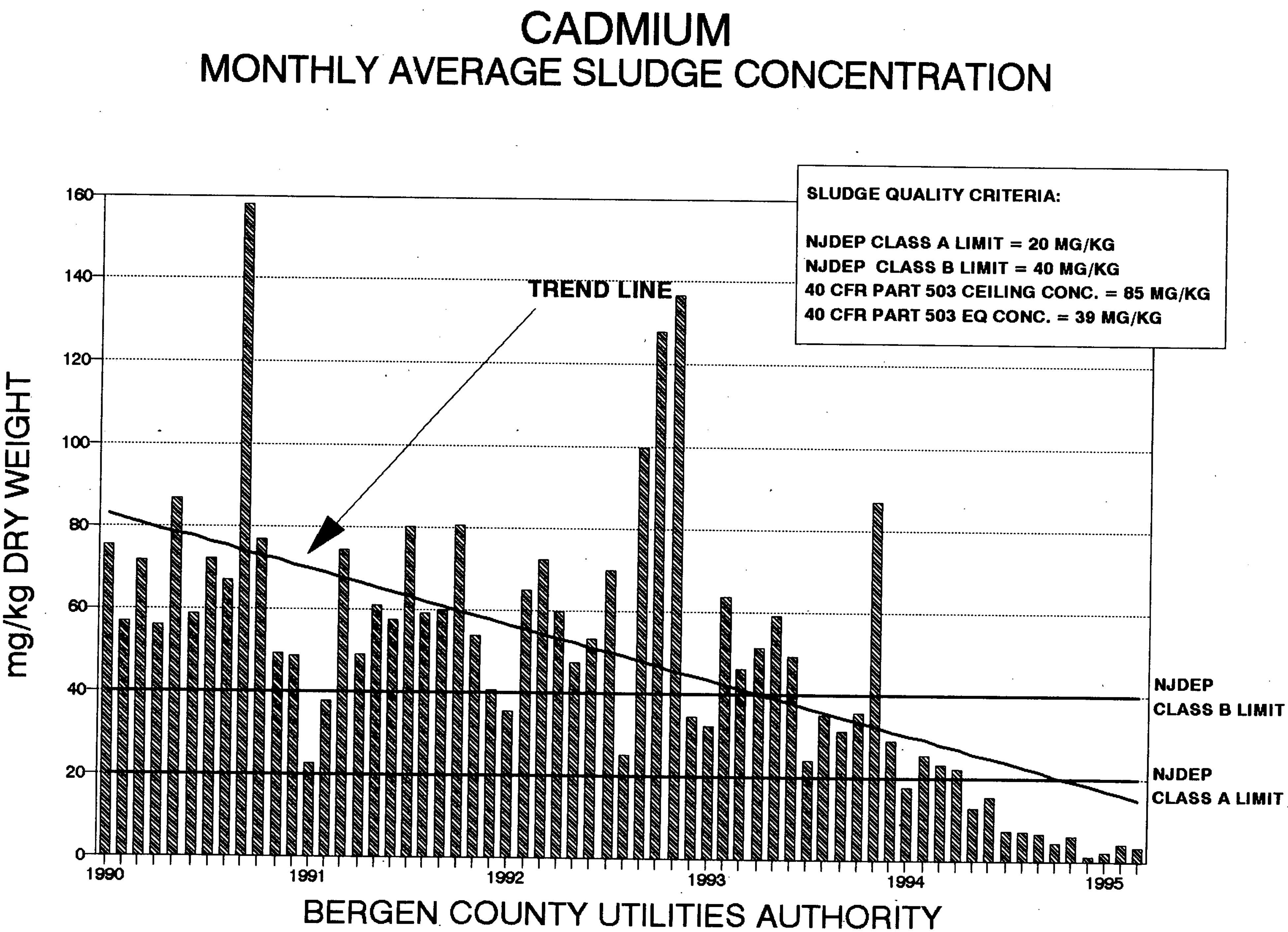

ARSENIC
MONTHLY AVERAGE SLUDGE CONCENTRATION
mg/kg DRY WEIGHT
76 MG/KG
SLUDGE QUALITY CRITERIA:
NJDEP CLASS A LIMIT = 10 MG/KG
NJDEP CLASS B LIMIT = 10 MG/KG
40 CFR PART 503 CEILING CONC. = 75 MG/KG
40 CFR PART 503 EQ CONC. = 41 MG/KG
NJDEP CLASS A AND B LIMIT
TREND LINE
0
2
4
6
8
10
12
14
16
18
20
1990
1991
1992
1993
1994
1995
BERGEN COUNTY UTILITIES AUTHORITY

Figure 3-1



CADMIUM
MONTHLY AVERAGE SLUDGE CONCENTRATION
SLUDGE QUALITY CRITERIA:
NJDEP CLASS A LIMIT = 20 MG/KG
NJDEP CLASS B LIMIT = 40 MG/KG
40 CFR PART 503 CEILING CONC. = 85 MG/KG
40 CFR PART 503 EQ CONC. = 39 MG/KG
TREND LINE
mg/kg DRY WEIGHT
0
20
40
60
80
100
120
140
160
NJDEP
CLASS B LIMIT
NJDEP
CLASS A LIMIT
1990
1991
1992
1993
1994
1995
BERGEN COUNTY UTILITIES AUTHORITY

Figure 3-2

CHROMIUM
MONTHLY AVERAGE SLUDGE CONCENTRATION

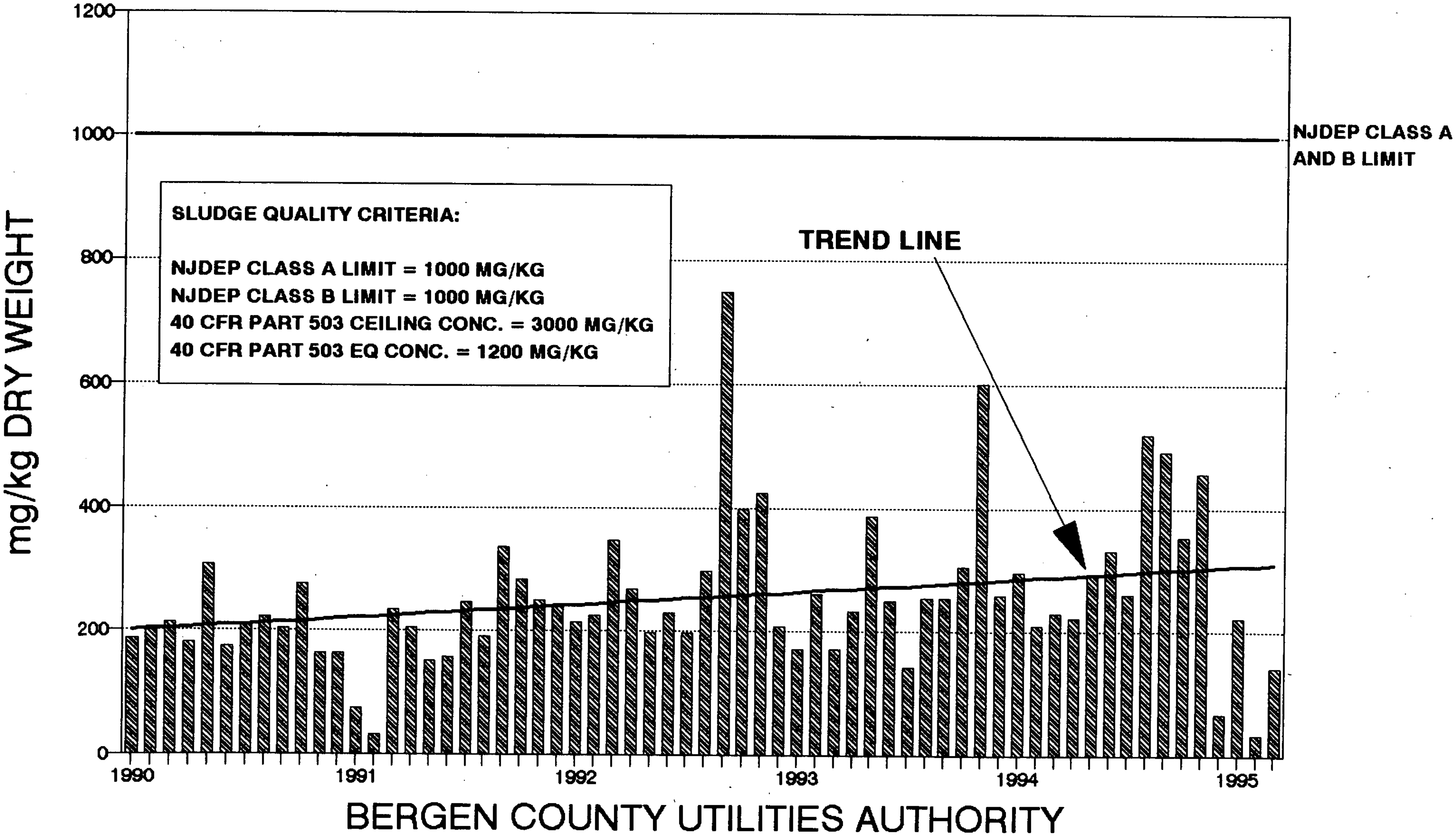


Figure 3-3

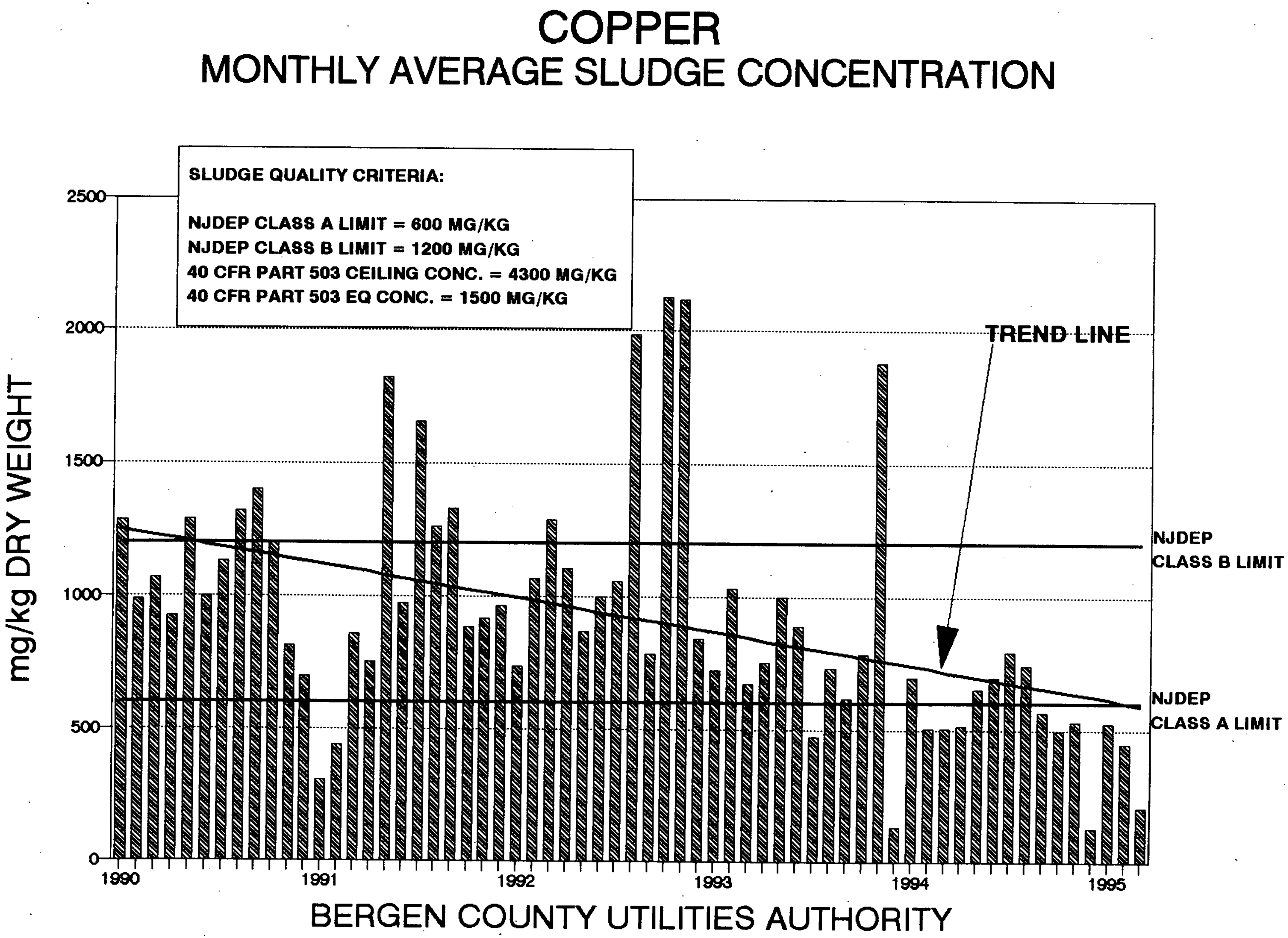
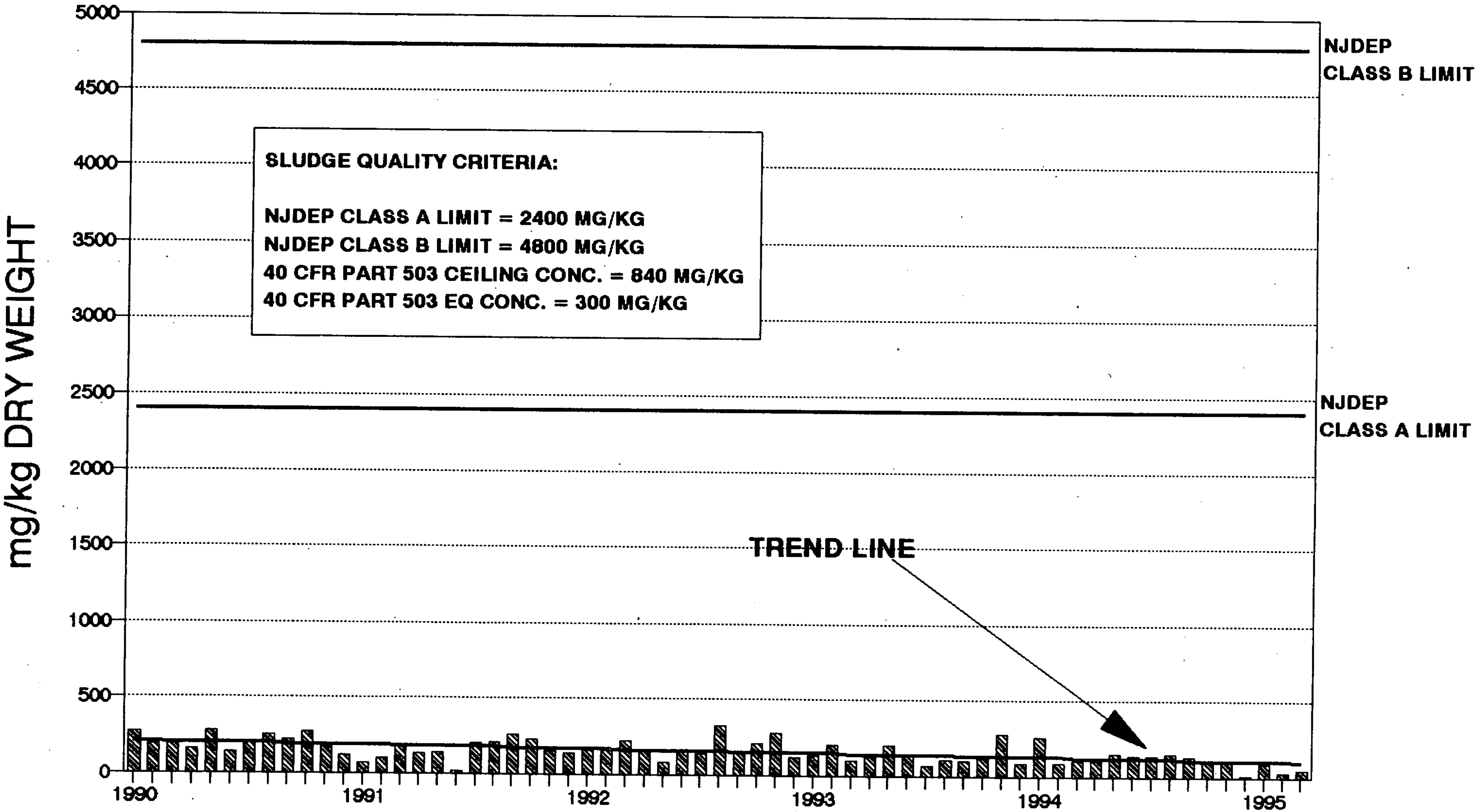

COPPER
MONTHLY AVERAGE SLUDGE CONCENTRATION
SLUDGE QUALITY CRITERIA:
NJDEP CLASS A LIMIT = 600 MG/KG
NJDEP CLASS B LIMIT = 1200 MG/KG
40 CFR PART 503 CEILING CONC. = 4300 MG/KG
40 CFR PART 503 EQ CONC. = 1500 MG/KG
TREND LINE
NJDEP
CLASS B LIMIT
NJDEP
CLASS A LIMIT
mg/kg DRY WEIGHT
2500
2000
1500
1000
500
0
1990
1991
1992
1993
1994
1995
BERGEN COUNTY UTILITIES AUTHORITY

Figure 3-4

LEAD
MONTHLY AVERAGE SLUDGE CONCENTRATION



BERGEN COUNTY UTILITIES AUTHORITY

Figure 3-5

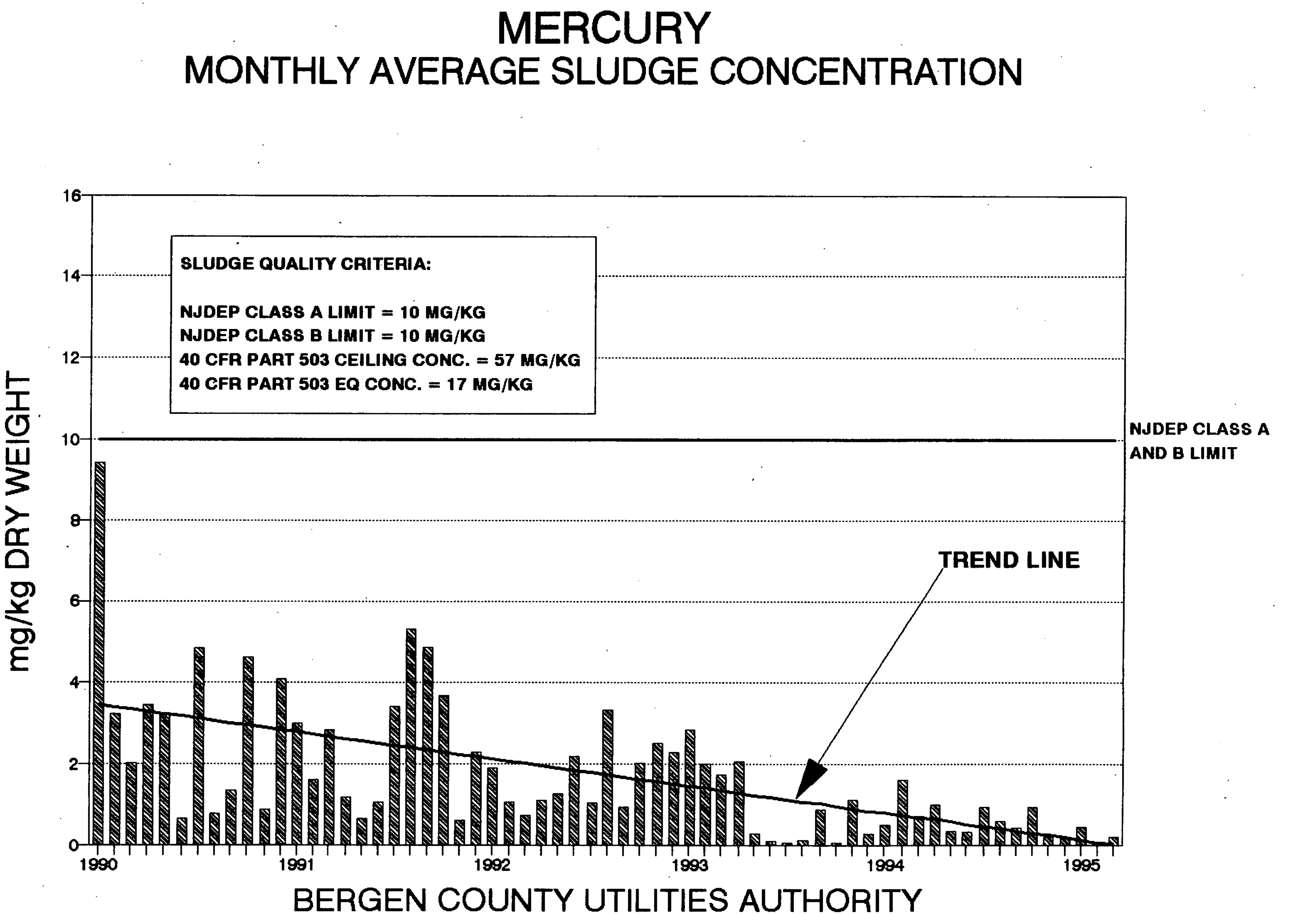

MERCURY
MONTHLY AVERAGE SLUDGE CONCENTRATION
SLUDGE QUALITY CRITERIA:
NJDEP CLASS A LIMIT = 10 MG/KG
NJDEP CLASS B LIMIT = 10 MG/KG
40 CFR PART 503 CEILING CONC. = 57 MG/KG
40 CFR PART 503 EQ CONC. = 17 MG/KG
NJDEP CLASS A AND B LIMIT
TREND LINE
mg/kg DRY WEIGHT
0
2
4
6
8
10
12
14
16
1990
1991
1992
1993
1994
1995
BERGEN COUNTY UTILITIES AUTHORITY

Figure 3-6

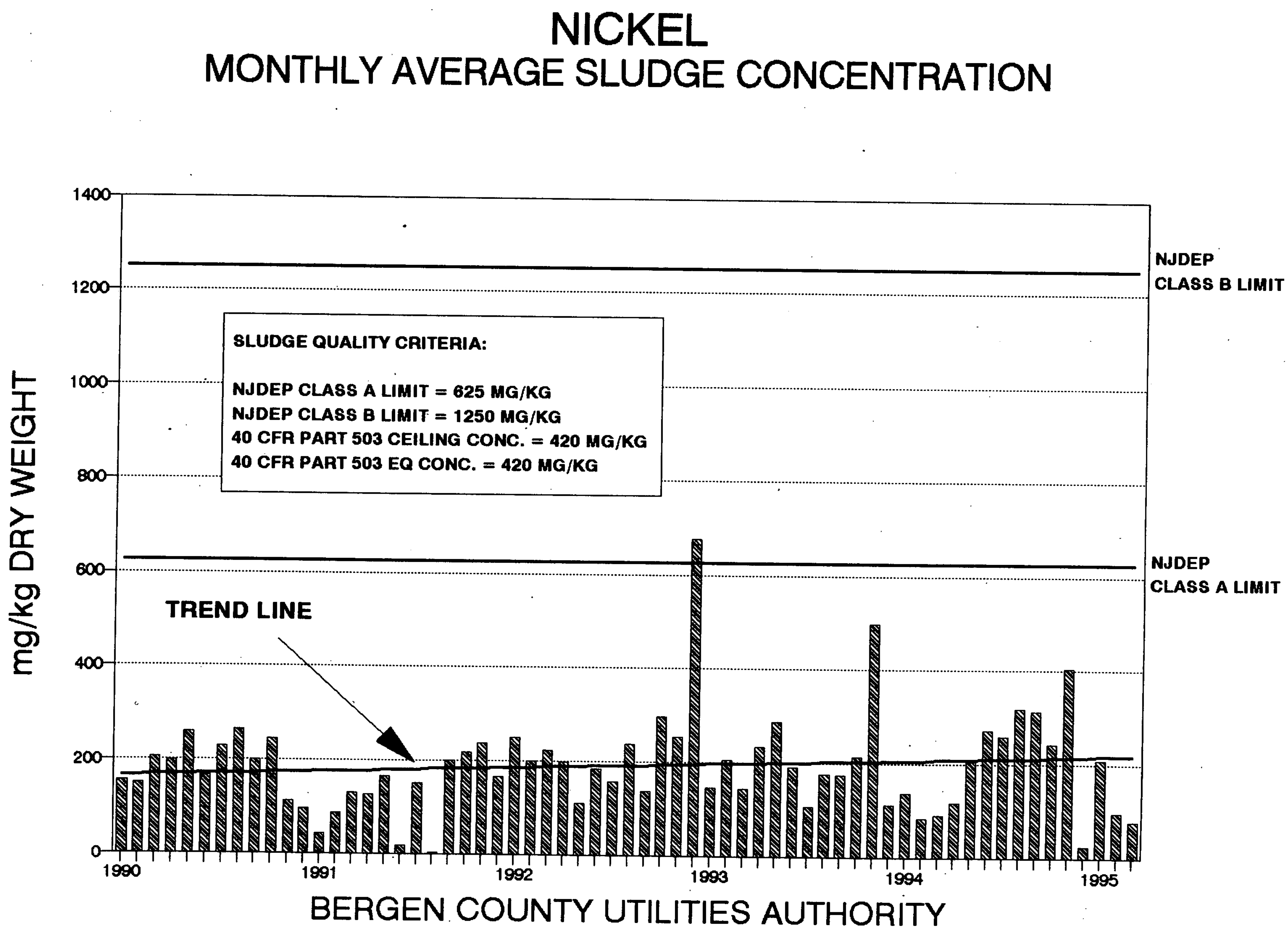

NICKEL
MONTHLY AVERAGE SLUDGE CONCENTRATION
mg/kg DRY WEIGHT
1400
1200
1000
800
600
400
200
0
NJDEP
CLASS B LIMIT
SLUDGE QUALITY CRITERIA:
NJDEP CLASS A LIMIT = 625 MG/KG
NJDEP CLASS B LIMIT = 1250 MG/KG
40 CFR PART 503 CEILING CONC. = 420 MG/KG
40 CFR PART 503 EQ CONC. = 420 MG/KG
NJDEP
CLASS A LIMIT
TREND LINE
1990
1991
1992
1993
1994
1995
BERGEN COUNTY UTILITIES AUTHORITY

Figure 3-7

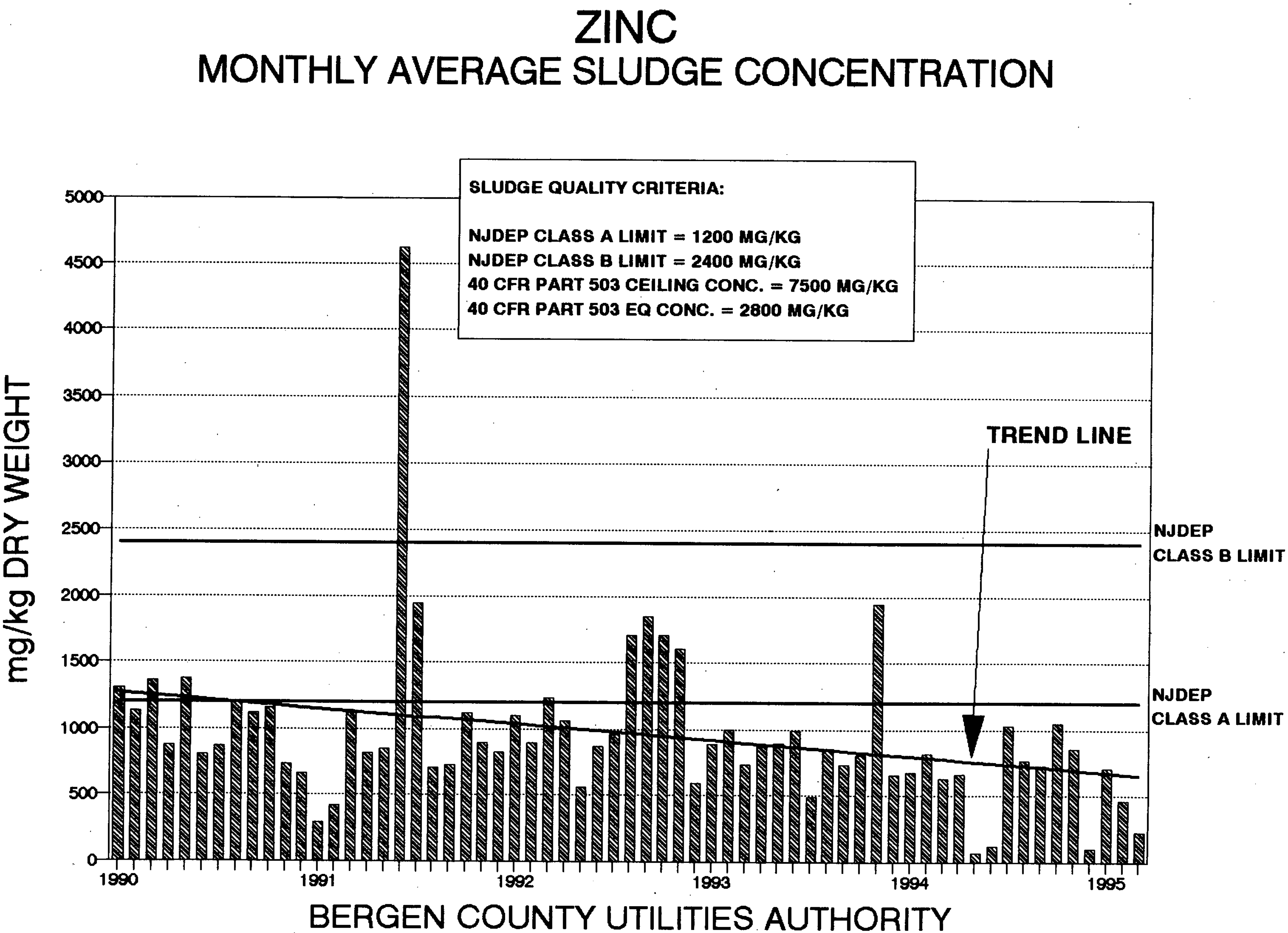

ZINC
MONTHLY AVERAGE SLUDGE CONCENTRATION
SLUDGE QUALITY CRITERIA:
NJDEP CLASS A LIMIT = 1200 MG/KG
NJDEP CLASS B LIMIT = 2400 MG/KG
40 CFR PART 503 CEILING CONC. = 7500 MG/KG
40 CFR PART 503 EQ CONC. = 2800 MG/KG
TREND LINE
NJDEP
CLASS B LIMIT
NJDEP
CLASS A LIMIT
mg/kg DRY WEIGHT
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1990
1991
1992
1993
1994
1995
BERGEN COUNTY UTILITIES AUTHORITY

Figure 3-8

defines all NJDEP sludge use and disposal requirements. The NJDEP has recognized the BCUA's efforts to improve sludge quality by officially upgrading the sludge to Class "B" on January 17, 1995. The BCUA's sludge quality also satisfies stringent federal sludge quality standards discussed in detail in Section 3.3.2 of this report. These state and federal sludge use criteria are also depicted in Figures 3-1 through 3-8 for comparison with actual BCUA sludge quality. This improvement in sludge quality should allow the BCUA to explore markets for beneficial use of its chemically stabilized sludge.

The enforcement actions taken against industrial users for permit violations are described in the Enforcement Response Plan (ERP) contained in Appendix D of the BCUA's Rules and Regulations. The primary purpose of the ERP is to set forth procedures indicating how the BCUA will investigate and respond to instances of industrial user non-compliance. The goals in undertaking the respective enforcement actions are to secure compliance with pretreatment requirements and, when appropriate, recoup any damages suffered by the BCUA, the local community, or the environment. The enforcement actions taken in response to industrial user violations in escalating order include a Clarification Request/Warning, Notice of Violation, Compliance Order, Consent Order, Order to Show Cause, Civil Action, Civil Administrative Penalties, Criminal Action, and termination of services. In deciding which enforcement response to select the BCUA gives consideration to the magnitude of the violation, duration of the violation, effect of the violation on the Hackensack River or other receiving water, effect of the violation on the treatment works, compliance history of the permittee, and good faith of the permittee. The development of an ERP is a federal requirement. The BCUA is the first local pretreatment program in New Jersey to draft and implement an ERP.

3.3.2 Standards for the Use or Disposal of Sewage Sludge

Prior to 1991, sewage sludge was regulated under various environmental statutes depending on the method of final disposal. Sludge disposed in landfills was regulated by the 40 CFR Part 257 solid waste disposal regulations while sludge dumped in oceans and estuaries was regulated by the Marine Protection, Research and Sanctuaries Act. The passage of the Ocean Dumping Ban Act of 1988 prevented further use of this sludge disposal practice. The six wastewater treatment authorities in New Jersey that had been utilizing ocean disposal were ordered to terminate this method of disposal by March 17, 1991. The BCUA, as one of these former ocean dumpers, met this deadline and instituted a successful land-based sludge management program. The unit processes utilized by the BCUA to treat the sludge are described in Section 2.4 of this report.

In many regions of the United States, sludge use as a fertilizer or soil amendment is commonplace. Sludge is high in organic content, tends to improve the ability of soil to retain moisture, and reduces the dependence of the agricultural industry on petroleum-based nitrogen fertilizers. However, sludge may contain pollutants and pathogens that have the potential to jeopardize public health and the environment if not properly controlled. Recognizing this potential threat, the United States Congress directed the USEPA to develop national standards for sludge use and disposal with the passage of the Clean Water Act of 1977.

The USEPA issued the final 40 CFR Part 503 Standards for the Use or Disposal of Sewage Sludge in the Federal Register on February 19,

1993. These standards were developed to protect public health and the environment from any reasonably anticipated adverse effects from the use and disposal of sewage sludge. The regulations address three sewage sludge use and disposal practices:

1. Marketing and distribution for land application;
2. Disposal at dedicated sites or sludge-only landfills; and
3. Incineration in sludge-only incinerators.

The 40 CFR Part 503 rule represents the first attempt on the part of the USEPA to develop comprehensive regulations that apply to the production or preparation of sludge, the use and disposal of sludge, and the quality of the sludge that is used or disposed of by the three methods described in the rule.

The rule has been organized into the following subparts:

1. General Provisions
2. Land Application
3. Surface Disposal
4. Pathogen and Vector Attraction Reduction
5. Incineration

Each of these subparts includes sections addressing applicability, general requirements, pollutant limits, operational requirements, management practices, and monitoring, record-keeping and reporting requirements.

Certain sludge disposal practices are not regulated by the 40 CFR Part 503 rule. One widespread practice, disposal of sludge in a municipal solid waste landfill, is covered by 40 CFR Part 258, not

Part 503. Compliance with municipal solid waste landfill regulations constitutes compliance with the Clean Water Act. However, a facility that sends its sewage sludge to a municipal solid waste landfill, either for disposal or for landfill cover, must meet certain requirements of 40 CFR Part 503 even though the landfill is regulated under 40 CFR Part 258. The treatment works producing the sewage sludge must ensure that the material is non-hazardous and non-liquid. The treatment plant must also submit general permit application information to the USEPA whether or not the use or disposal option chosen by the facility if regulated by 40 CFR Part 503. In addition, the treatment plant must submit an annual report to the USEPA describing the sludge disposal practices utilized during the previous year.

While the USEPA promotes the use of sewage sludge for its beneficial properties, the 40 CFR Part 503 rule is not intended to dictate sewage sludge use and disposal options to a local community. While the choice of a particular use or disposal practice remains with the local community, the USEPA has developed stringent pollutant limits for many use and disposal practices. The result is that some generators will not meet the sludge quality limits that have been promulgated for beneficial reuse practices and the choice of use and disposal options will be reduced significantly. Even if stringent sludge quality limitations are met, there is no guarantee that beneficial reuse, particularly land application, is a practical alternative for all sludge producers.

The 40 CFR Part 503 rule establishes maximum pollutant concentrations for ten metals for sludge that is land applied. These are referred to as the Pollutant Ceiling Concentrations and are presented in Table 3-3. These limitations pertain to the quality of the final sewage sludge product that is applied to the land. The sludge product cannot be land applied if the metals exceed the Pollutant Ceiling Concentrations. If a facility cannot meet these Pollutant Ceiling Concentrations, other disposal options must be considered.

The 40 CFR Part 503 Cumulative Pollutant Loading Rates and Pollutant Concentrations are also listed in Table 3-3. If sludge quality meets the Pollutant Ceiling Concentrations, the material can be land applied. If sludge is land applied, than either the Cumulative Pollutant Loading Rates listed in Table 3-3 must not be exceeded or the Pollutant Concentrations listed in Table 3-3 must not be exceeded. A Cumulative Pollutant Loading Rate is the maximum amount of an inorganic pollutant, such as a metal, that can be applied to an area of land during the entire life of the application site. Compliance with the Cumulative Pollutant Loading Rates requires that the metals concentrations and loadings in the sludge are monitored frequently and reported to the USEPA. If the sludge quality meets the Pollutant Concentrations, however, the material is classified as "Exceptional Quality", which allows unlimited application to a beneficial use site and vastly reduces the record-keeping and monitoring requirements for the sludge producer.

The yearly average concentrations of the metals of concern for the BCUA's sludge and the 40 CFR Part 503 sludge quality criteria for land application are presented in Table 3-4. The concentrations of metals in BCUA sludge fall well below the Pollutant Ceiling Concentrations. In the past, cadmium concentrations were frequently exceeded. Cadmium sources in the collection system were researched and enforcement actions were taken by the Industrial

Bergen County Utilities Authority
Water Pollution Control Division

Table 3-3

Standards for the Use and Disposal of Sewage Sludge

Pollutant	Pollutant Ceiling Concentrations (mg/kg)	Cumulative Pollutant Loading Rates		Pollutant Concentrations ("Exceptional Quality") (mg/kg)
		(Kg/hectare)	(lb/acre)	
Arsenic	75	41	37	41
Cadmium	85	39	35	39
Chromium	3000	3000	2700	1200
Copper	4300	1500	1350	1500
Lead	840	300	270	300
Mercury	57	17	15	17
Molybdenum	75	18	16	18
Nickel	420	420	378	420
Selenium	100	100	90	100
Zinc	7500	2800	2520	2800

Bergen County Utilities Authority
Water Pollution Control Division

Table 3-4

Comparison of Sludge Quality Criteria with BCUA's Sludge Quality

	40 CFR Part 503 Pollutant Ceiling Concentrations (mg/kg)	40 CFR Part 503 Pollutant Concentrations (mg/kg)	NJDEP Class "A" Land Application Criteria (mg/kg)	NJDEP Class "B" Land Application Criteria (mg/kg)	BCUA's Yearly Average 1994 Sludge Quality (mg/kg)
Arsenic	75	41	10	10	1.8
Cadmium	85	39	20	40	12.4
Chromium	3000	1200	1000	1000	311
Copper	4300	1500	600	1200	568
Lead	840	300	2400	4800	120
Mercury	57	17	10	10	0.6
Molybdenum	75	18	No Limit	No Limit	7.4
Nickel	420	420	625	1250	206
Selenium	100	36	No Limit	No Limit	1.1
Zinc	7500	2800	1200	2400	623

Pretreatment Program to ensure that industrial dischargers are complying with permit limitations. The activities of the Industrial Pretreatment Program related to the achievement of sludge quality goals are described in greater detail in Section 3.3.1 of this report.

The concentrations of metals in the BCUA's sludge were also below the Pollutant Concentrations during all of 1994 and 1995 to date. While the concentrations of these metals might be below the limitations, continued enforcement of the Industrial Pretreatment Program is necessary to insure continued compliance. As long as the sludge produced by the BCUA can meet the Pollutant Ceiling Concentrations, land application alternatives can be considered whether or not the Pollutant Concentrations are met. However, meeting the "Exceptional Quality" criteria will allow the BCUA to exploit more markets for beneficial reuse and reduce sludge disposal costs.

One important factor to consider is that sludge may not be applied to a land application site at a rate that exceeds the agronomic rate for the sludge. The agronomic rate is the ratio of the nitrogen used by the crop grown on the application site to the available nitrogen in the sludge. This rate is designed to provide the amount of nitrogen needed by the vegetation while minimizing the amount of nitrogen that leaches throughout the soil to contaminate groundwater. For most land applications sites, the agronomic rate will limit the amount of sludge that can be applied to an area, not the Cumulative Pollutant Loading Rates.

A major issue for every generator of sludge choosing beneficial reuse as a disposal alternative will be the individual state requirements that are promulgated as a result of the 40 CFR Part 503 regulations. Many states have issued sludge use and disposal regulations based on local concerns that contain more stringent numerical limits and additional regulated pollutants. Many states, including New Jersey, have expressed a reluctance to adopt the 40 CFR Part 503 rule as written. While states may not adopt limitations that are less stringent than the 40 CFR Part 503 regulations, they may choose to adopt more stringent limitations for some or all pollutants. In addition to the 40 CFR Part 503 criteria, Table 3-4 presents the NJDEP Class "A" and Class "B" Land Application Criteria adopted in 1987. This data reveals that the BCUA sludge quality is acceptable for beneficial reuse according to both federal and state standards.

In addition to the pollutant limitations, the 40 CFR Part 503 rule establishes strict requirements for pathogen reduction and vector attraction reduction. Pathogens are organisms such as bacteria, viruses, protozoa and intestinal parasites that are capable of causing disease. Vector attraction is the characteristic of sewage sludge that attracts rodents, flies, mosquitos or other organisms capable of transporting infectious agents. Pathogen content and vector attraction are characteristics of sewage sludge that directly affect the potential of sewage sludge use or disposal to compromise public health. The pathogen reduction and vector attraction reduction requirements in the 40 CFR Part 503 rule are designed to ensure that the use and disposal of sewage sludge in land application or surface disposal sites does not endanger public health.

The control of pathogens in sewage sludge is not a new concept. Prior to the 40 CFR Part 503 rule, sewage sludge pathogen control was demonstrated through the use of certain treatment processes that provided the required level of pathogen reduction. For instance, regulations adopted by the NJDEP in the 1987 New Jersey State Sludge Management Plan pertaining to the land application of sludge in New Jersey specify that sludges must be treated with a Process to Significantly Reduce Pathogens (PSRP) or a Process to Further Reduce Pathogens (PFRP) as per 40 CFR Part 257. Anaerobic digestion of sludge is one of the processes that satisfies the definition of PSRP. Chemical stabilization is considered a PFRP process.

The 40 CFR Part 503 pathogen reduction alternatives do not specify the type of processes to be used to eliminate the pathogens. Any process that meets the pathogen density and vector attraction reduction performance levels and operating parameters can be used. Laboratory monitoring of pathogen densities to demonstrate pathogen reduction will be required to ensure the reliability of the sludge treatment process. Sludges that are acceptable for land application are classified as either Class A or Class B. This classification system is not to be confused with the NJDEP classification system based on pollutant concentrations which uses the same nomenclature. Sludge not meeting the Class A or Class B pathogen criteria are considered unsuitable for land application according to the 40 CFR Part 503 rule.

In order for sludge to be classified as Class A with respect to pathogens, the sludge must meet the requirements of one of six treatment alternatives. All the Class A pathogen reduction alternatives require that the sewage sludge meet specific limitations for fecal coliform and *Salmonella* concentrations. These criteria must be met at the time the sludge product is land applied. The six alternatives encompass a wide range of operational possibilities including alkaline stabilization and other PFRP methods. Requirements for Class B sludge are less stringent than the Class A requirements. Class B sludge must meet one of three criteria and must be land applied according to certain site restrictions.

Vector attraction reduction criteria are separate from but related to the pathogen reduction criteria. Land application of sewage sludge requires the implementation of one of eleven vector attraction reduction alternatives. Most of the alternatives chosen to achieve Class A or B pathogen reduction criteria will also satisfy the vector attraction reduction requirements.

The future of the BCUA sludge management program depends on producing a high quality sludge with more land application possibilities and fewer restrictions imposed on it than a poorer quality sludge. Sludge can no longer be regarded as a waste material to be disposed of indiscriminately, but must be considered a product to be used beneficially. As such, the quality of this product must be of paramount importance to any generator of sludge planning on exploiting a beneficial use sludge management strategy.

3.4 Water Quality Act of 1987

The Federal Water Pollution Control Act of 1972 resulted in virtually all municipal wastewater treatment facilities being upgraded to secondary treatment. The Clean Water Act of 1977 strengthened the standards for industrial dischargers and provided municipal treatment facilities with the means to control pollutants entering their plants. Despite the progress made in these areas of water pollution control, many water bodies had still not attained a full range of desirable uses. Furthermore, many states had failed to promulgate the water quality standards for toxic pollutants mandated in the Federal Water Pollution Control Act of 1972. Without justifiable water quality standards for toxics, the states cannot develop permit limitations for dischargers to surface waters for toxic pollutants.

With the passage of the Water Quality Act of 1987, water quality-based standards once again assumed a regulatory role equal to that of the technology-based standards. The individual states were given stringent deadlines by which water quality standards for toxic pollutants were to be developed and adopted. Where data was insufficient to develop water quality standards for specific chemicals, states were to use biomonitoring techniques to develop whole effluent toxicity limitations for dischargers. In a whole effluent toxicity test, organisms are exposed to increasing dilutions of a wastewater effluent to observe the toxic effects on the organisms. This federal program resulted in BCUA having to perform the costly Toxicity Reduction Evaluation described below.

The Act also directed the USEPA to develop national water quality standards for toxic pollutants. States that failed to meet the deadlines for developing their own standards were required to adopt the national standards. New Jersey, as one of the states which had failed to develop surface water quality standards for toxics, adopted the national standards on December 6, 1993. As a result, the national standards for pollutants such as metals and organic compounds now apply to the Hackensack River. If the concentrations of any of the listed pollutants in the Hackensack River exceed the water quality standard for that pollutant, then the state may develop NJPDES permit limitations for dischargers to the Hackensack River, including the BCUA.

Another important program mandated by the Water Quality Act of 1987 is the National Estuary Program. This program was established to promote long-term planning and management in nationally significant estuaries threatened by pollution, development or overuse. The states participating in the program must prepare comprehensive management plans for the regions which address pollution control, public education and pollution prevention. The goal of the program is to manage estuaries and the tributaries that drain into estuaries as one ecosystem. To accomplish the program goals, working partnerships are encouraged among federal, state and local governments, industry, public interest groups and the scientific community. The New York/New Jersey Harbor is one of the systems that has been included in the National Estuary Program. All point source discharges to this estuary, including the BCUA, are impacted by this program.

3.4.1 Toxicity Reduction Evaluation

The Federal Water Pollution Control Act of 1972 established the national policy of eliminating the discharge of toxic pollutants in toxic amounts. The traditional approach to achieving this goal is the chemical-specific approach, whereby individual pollutants are identified and their effects on receiving systems are evaluated using toxicological data. Presumably, toxicants causing or suspected of causing damage to receiving systems would be controlled through NPDES permits. Using this approach, most efforts were concentrated on the 126 priority pollutants listed by the USEPA as the most serious environmental threats.

The USEPA recognized certain limitations in the chemical-specific approach. Toxicological data obtained for single pollutants does not account for the combined effects of multiple toxicants on aquatic organisms. Many pollutants, especially organic pollutants, are toxic below the levels that can be tested using traditional laboratory analytical techniques. Furthermore, many pollutants produced by large chemical and pharmaceutical industries are protected trade secrets, and their chemical composition may not be known, much less analyzed. For these reasons, the USEPA has developed guidance for conducting whole effluent toxicity testing to control the discharge of toxic pollutants. The USEPA has given the states much flexibility in developing their own toxicity testing programs.

Since 1985, the NJDEP has required the BCUA to measure the toxicity of the wastewater treatment plant effluent using bioassay procedures. In a bioassay, organisms such as algae, macroinvertebrates, or fish are exposed to a wastewater treatment plant effluent for a prescribed time period. The response of the organisms to the effluent at the end of the period is observed and statistical procedures are used to calculate the toxicity of the effluent relative to a standard. The response measured in the test is usually the death of the organism, but sublethal endpoints such as growth or fecundity are also used to measure toxicity.

The NJPDES permit issued by the NJDEP in 1985 required the BCUA to conduct quarterly testing of both acute and chronic toxicity using the macroinvertebrate *Mysidopsis bahia*. Acute toxicity refers to the short-term effects of an effluent on the test organisms while chronic toxicity refers to the long-term effects of the effluent on the test organisms. Acute toxicity is expressed as an LC_{50}, the concentration of effluent that results in the death of 50% of the test organisms within the test period, usually 96 hours. Chronic toxicity is expressed as a No Observed Effect Concentration (NOEC), the highest concentration to which the organisms are exposed that causes no adverse effect on the test organisms during a seven day period. The minimum New Jersey state standard for acute toxicity is $LC_{50} \geq 50\%$ effluent. The standard for chronic toxicity is dependent upon the dilution of the effluent in the particular receiving water into which the treatment plant effluent is discharged.

The early acute toxicity data submitted to the NJDEP indicated that the BCUA treatment plant effluent frequently violated the minimum state standard. Therefore, the NJDEP required the performance of a Toxicity Reduction Evaluation (TRE) as a condition of the NJPDES permit which became effective on March 1, 1990. A TRE is a complex study designed to identify and remove the pollutants causing effluent toxicity. The USEPA has described the methods for conducting a TRE in various guidance manuals published in the late 1980s. The test procedures used in a TRE are highly specialized, and are, therefore, both difficult and expensive to perform. Complex bioassay testing is conducted to characterize the effluent toxicity and subsequent laboratory analytical procedures are applied to identify and confirm the presence of specific pollutants.

The BCUA was required to identify and remove the factors causing acute toxicity by June 4, 1992 at which time the NJPDES acute toxicity permit limitation of $LC_{50} \geq 50\%$ became enforceable. During the performance of the TRE, the BCUA experienced some difficulty identifying the specific pollutants causing effluent toxicity. The first phase of the TRE revealed that ammonia was the primary contributor to effluent toxicity. The results suggested that other toxicants were also present, but the ammonia had a masking effect on the minor toxicants that made their identification impossible. Furthermore, the ammonia toxicity was exacerbated by the use of laboratory test conditions that did not adequately control pH drift. Since ammonia is more toxic at high pH than low pH, it was important to develop an appropriate test protocol to control pH during toxicity tests. A modified test protocol was developed and approved by the NJDEP in September 1992, which allowed the BCUA to more accurately estimate the acute toxicity of the effluent.

Despite the test protocol modification, the BCUA was unable to identify specific toxicants other than ammonia. However, during this period, the quality of the BCUA effluent improved significantly. In addition to the modification of the testing methods, the improvement has been attributed to the following factors:

- Continued development, implementation and enforcement of the Industrial Pretreatment Program;
- Development of public education, pollution prevention and household hazardous waste collection programs; and
- Reduction in the number of industrial users discharging to the BCUA.

Table 3-5 presents the results of the BCUA's acute and chronic whole effluent toxicity tests since 1990. Bioassay monitoring for acute toxicity indicates the BCUA effluent has been in compliance with the NJPDES permit limitation of $LC_{50} \geq 50\%$ effluent since March 1993. On December 13, 1994 the BCUA received correspondence from the NJDEP acknowledging continued compliance with the acute toxicity permit limitation and allowing the BCUA to discontinue the TRE.

Since pollution control regulations in New Jersey mandate penalties and fines of up to $50,000 per day for even one permit limitation excursion, compliance with the acute toxicity limitation was an important achievement for the BCUA. The programs responsible for improvement of the effluent should be continued. However, some

BERGEN COUNTY UTILITIES AUTHORITY

TABLE 3-5

SUMMARY OF MYSID BIOASSAY DATA

DATE	ACUTE TOXICITY 96-hr LC50 (%)	CHRONIC TOXICITY 7-d NOEC (%)	7-d LOEC (%)
JANUARY 1990	45	ND	ND
FEBRUARY 1990	28	ND	ND
JULY 1990	100	ND	ND
AUGUST 1990	100	ND	ND
SEPTEMBER 1990	100	ND	ND
OCTOBER 1990	62	ND	ND
NOVEMBER 1990	6	ND	ND
DECEMBER 1990	17	ND	ND
JANUARY 1991	36	ND	ND
FEBRUARY 1991	62	12.5	25
MARCH 1991	29	50	100
APRIL 1991	38	50	100
MAY 1991	62	25	50
JUNE 1991	40	12.5	25
JULY 1991	78	50	100
AUGUST 1991	100	25	50
SEPTEMBER 1991	68	6.25	12.5
OCTOBER 1991	58	25	50
NOVEMBER 1991	100	25	50
DECEMBER 1991	78	30	50
JANUARY 1992	66	6.25	12.5
FEBRUARY 1992	35	12.5	25
MARCH 1992	64	6.25	12.5
APRIL 1992	60	6.25	12.5
MAY 1992	58	33	50
SEPTEMBER 1992 *	73	50	100
DECEMBER 1992	48	50	100
MARCH 1993	57	25	33
JUNE 1993	61	12.5	25
SEPTEMBER 1993	91	12.5	25
DECEMBER 1993	61	50	100
MARCH 1994	100	33	50
JUNE 1994	69	50	100
SEPTEMBER 1994	91	12.5	25
DECEMBER 1994	81	50	100

* Mysidopsis bahia acute tests performed according to modified NJDEP protocol after September 1992.

additional toxicity issues remain unresolved.

Within the next year, the BCUA may expect the NJDEP to issue an enforceable NJPDES permit chronic toxicity limitation. Available data indicates that the BCUA effluent exhibits sporadic chronic toxicity and it is likely that the BCUA will be required to initiate a chronic TRE to comply with the chronic toxicity permit limitation. It is possible that some steps may be taken before the issuance of a chronic toxicity permit limitation, such as the development of a chronic toxicity test protocol modification, which will preclude the necessity of initiating a chronic TRE. The BCUA established a cooperative relationship with the NJDEP during the acute TRE, which is expected to continue during the resolution of these chronic toxicity issues.

3.4.2 New York/New Jersey Harbor Estuary Program

The New York/New Jersey Harbor Estuary encompasses the waters of the New York/New Jersey Harbor and all of the tributaries that drain into it. With a surface area of approximately 300 square miles, the region includes the Hudson River, the Passaic River, the East River, the Harlem River, the Hackensack River, the Raritan River, the Arthur Kill, the Kill Van Kull, Jamaica Bay, Newark Bay, Raritan Bay and many other minor tributaries. The ecosystem supports a great diversity of aquatic life and serves as a breeding ground for many species of fish and wildlife. The region also has commercial significance as an industrial base for the New York Metropolitan Area. Since the area is important as both an ecological and economic resource, the New York/New Jersey Harbor Estuary became a candidate for inclusion in the National Estuary Program established by the Water Quality Act of 1987. Since the inclusion of this ecosystem in the program, an array of federal, state and local agencies in both New York and New Jersey have coordinated their management efforts under the auspices of the New York/New Jersey Harbor Estuary Program (HEP).

The HEP has drafted a Comprehensive Conservation and Management Plan (CCMP) for the New York/New Jersey Harbor which describes all of the water pollution control objectives for this system. Some of the items in the CCMP, such as the control of floatables from combined sewer overflows, do not have immediate significance for the BCUA. A few issues addressed in the CCMP, however, have required the participation of the BCUA and other wastewater treatment agencies in New Jersey. These issues include the discharge of toxic pollutants and the discharge of nutrients into the New York/New Jersey Harbor. Nutrient issues are discussed separately in Section 3.5.1 of this report.

As directed by the Water Quality Act of 1987, the USEPA has developed national water quality standards applicable to all surface waters for toxic pollutants, including metals and organic contaminants. The HEP has identified impairments to aquatic life in the New York/New Jersey Harbor Estuary and has determined that metals and organic contaminants are contributing to the observed degradation. Preliminary studies conducted by the USEPA have indicated that copper, lead, mercury and nickel exceed the existing water quality criteria in these waters. Since water quality criteria are developed to protect aquatic life from toxic effects, pollutants that exceed these criteria need to be controlled. The HEP also suspects that polychlorinated biphenyls (PCBs) and dioxin are contaminating the Estuary, but additional studies are needed before their effects can be evaluated.

Since metals have been identified as Estuary contaminants, the HEP has investigated the sources of metals so that controls can be implemented. These sources include industry, stormwater outfalls, combined sewer overflows, and wastewater treatment plant discharges in both New York and New Jersey. The HEP has undertaken a complex sampling and computer modeling program to evaluate the sources of toxic pollutants. Much of the data and computer modeling has been supported by the New York City Department of Environmental Protection (NYCDEP) which is responsible for all wastewater treatment plants, combined sewer overflows and stormwater outfalls in New York City. The conclusions drawn to date are based on computer models that predict which sources of metals are likely to be in excess of water quality criteria in the New York/New Jersey Harbor. While empirical data enhances the accuracy of the computer models, direct sampling of pollutant sources is difficult and costly to perform. The HEP has relied on the data provided by the NYCDEP to develop predictions of the behavior of metals in the Estuary using limited information regarding the actual contributions of wastewater treatment facilities in New Jersey.

The HEP has used the results of these metals studies to develop Total Maximum Daily Loadings (TMDLs) for copper, lead, mercury and nickel which describe the maximum amount of each metal which can be introduced into the New York/New Jersey Harbor that allows the applicable water quality criteria to be achieved. The TMDLs will then be allocated to the various metals sources, such as industry or stormwater. Referred to as Waste Load Allocations (WLAs), these allowable loadings for each source are based upon the results of predictive computer modeling. It is important to note that in the absence of real data, conservative assumptions are made about the nature of the metals source that tend to overestimate the impact of the source on the Estuary.

The results of the TMDL and WLA studies indicated that wastewater treatment plants are the largest single source of the metals of concern. The computer modeling evaluations also suggested that dischargers to the New Jersey tributaries seem to be contributing a greater loading of metals to the system than the dischargers to the New York waters. The NYCDEP has been an active participant in the development of the computer model on which these conclusions are based and provided much of the supporting data. There is some indication that data deficiencies for the New Jersey waters coupled with conservative assumptions regarding the discharge of metals from wastewater treatment plants in New Jersey are responsible for the apparent discrepancies. This discrepancy can lead to the development of an inappropriate metals loading allocation which, in turn, could result in overly restrictive permit limitations for New Jersey dischargers.

Since it appeared that dischargers in New Jersey contribute unacceptable loadings of metals to the Estuary, the wastewater treatment agencies discharging to the Estuary waters and tributaries were targeted for mitigation. On July 21, 1993 the USEPA issued a directive to eleven New Jersey wastewater treatment plants discharging to the waters of the New York/New Jersey Harbor requiring that each facility perform a complex study of the sources of metals in the collection system and the fate of metals in the treatment process. The studies were to include a review of Industrial Pretreatment Program requirements, an analysis of metals discharged through combined sewer overflows, and a review of the wastewater treatment process to optimize metals removals. The directive also included a requirement to conduct influent and effluent sampling and analyses for PCBs and dioxin using highly specialized laboratory analytical techniques, referred to as "clean" techniques.

The metals study requested by the USEPA was comprehensive and necessitated an analysis of metals sources over which New Jersey wastewater treatment agencies have limited jurisdiction, such as combined sewer overflows. Furthermore, certain aspects of the study, especially treatment process optimization for metals removal, were in conflict with other programs, such as beneficial use of sludge. The magnitude of the implications for dischargers in New Jersey prompted the affected agencies to form a consortium known as the New Jersey Harbor Dischargers Group (NJHDG). The NJHDG is comprised of the following agencies:

- Bergen County Utilities Authority
- Edgewater Municipal Utilities Authority
- Hoboken/Union City/Weehawken Sewerage Authority
- Joint Meeting of Essex and Union Counties
- Linden Roselle Sewerage Authority
- Middlesex County Utilities Authority
- North Bergen Municipal Utilities Authority
- Passaic Valley Sewerage Commissioners
- Rahway Valley Sewerage Authority
- Secaucus Municipal Utilities Authority
- West New York Municipal Utilities Authority

The NJHDG members have been working together to satisfy the requests for information related to the HEP studies. The eleven agencies developed a legal mechanism to obtain the laboratory services for the PCBs and dioxin analyses through a joint contract. The economy of scale enabled the NJHDG to obtain the laboratory services at a significant cost savings. Furthermore, the quality of the data provided was actually improved by working together because factors such as inter-laboratory variability were eliminated. The data for PCBs and dioxin will be used by the HEP to determine whether these organic compounds are likely causes of aquatic life impairments in the Estuary. The NJHDG will be completing the study and submitting the final report to the USEPA by June 30, 1995. Unfortunately, the issues related to the metals studies have proven more complex for the New Jersey dischargers.

One of the primary goals of the NJHDG was to open a dialogue with the USEPA to gain insight into the TMDL and WLA studies and their implications for New Jersey dischargers. The USEPA indicated that the studies would be used as the basis for future permit limitations for each agency. Since the data on which the TMDL and WLA studies were based are flawed with respect to New Jersey dischargers, the USEPA indicated that the NJHDG would be given an opportunity to supplement the metals data for the New Jersey side prior to the issuance of final permit limitations. The NJHDG has contracted a technical advisor to supplement the metals data for the New Jersey tributaries so that the metals loading allocations can be recalculated. A reevaluation of the current water quality of the New Jersey tributaries and the metals loadings from the New Jersey dischargers may reveal that the existing effluent quality of the NJHDG member agencies is consistent with the goals of the HEP. If so, costly mitigation measures to control metals discharges can be avoided.

The technical advisor contracted by the NJHDG developed a scope of work for the metals monitoring to be conducted in the ambient environment in and around the New Jersey tributaries and has initiated the first phase of sampling. Subsequent phases of the study will include more extensive sampling of the ambient environment and sampling of the individual wastewater treatment plant effluents. The USEPA and the NJDEP are in the process of developing NJPDES permit limitations for each discharger for copper, lead, mercury and nickel based on existing effluent quality. Permits are expected to be modified to include the limitations sometime during 1995. More stringent limitations will not be developed unless the results of the NJHDG studies indicate that they are necessary for the protection of water quality in the New York/New Jersey Harbor. The NJHDG members are fortunate to have gained the opportunity to revisit the metals allocations prior to the development of overly stringent permit limitations.

While the resolution of the metals loading allocation is the issue which precipitated the formation of the NJHDG, this group intends to continue addressing water quality issues as a unit. Working as a group seems to be an effective way to reduce costs and disseminate information. Continuing to participate is in the best interests of the BCUA.

3.5 Regulatory Issues Impacting Future Capital Projects

In recent decades, the pollution control responsibilities of wastewater treatment agencies have expanded to encompass pollutants and pollution sources that traditional secondary wastewater treatment facilities were not designed to treat. Some of these pollutants, such as metals, may be addressed through programs such as the IPP, or the Household Hazardous Waste Collection Program sponsored by the BCUA's Solid Waste Division. Other water pollution problems, such as nutrients, can be mitigated only through the construction of new facilities. A description of the regulatory programs which may require the construction of capital facilities is provided below. Since no long-term solution to these issues has been determined, it is important to insure that actions taken by the BCUA to address these issues are technically sound and fiscally responsible.

3.5.1 Nutrient Issues

A secondary wastewater treatment plant is designed to treat carbonaceous BOD and solids. Treatment plants that are designed to treat nitrogen or phosphorus compounds in addition to BOD and solids are considered tertiary treatment plants, or advanced wastewater treatment plants. Nitrogen and phosphorus, which are referred to as nutrients, are products of human biological processes and are normal constituents of wastewater treatment plant effluent. When discharged to surface waters, nutrients can cause numerous water quality problems which can impact the desired use of the water body. For this reason, the USEPA has developed a comprehensive management program for nutrients discharged to surface waters.

While nitrogen and phosphorus are both nutrients that can impact water quality under certain conditions, phosphorus tends to cause greater water quality degradation when discharged to a freshwater system, such as a stream or lake. Since the BCUA treatment plant discharges into the lower Hackensack River, which is a saline tidally influenced estuary, it is unlikely that the BCUA will be required to reduce the amount of phosphorus in the treatment plant effluent. Therefore, for the purposes of this report on issues affecting the BCUA, the discussion of nutrient issues will be limited to nitrogen.

Excessive nitrogen discharged to a receiving water can result in the following water quality problems:

1. Depletion of dissolved oxygen caused by nitrification;
2. Eutrophication; and
3. Ammonia toxicity.

Just as bacterial decomposition of the carbonaceous organic components of a wastewater depletes dissolved oxygen in a receiving water, the process of nitrification, which converts ammonium (NH_4^+) to nitrate (NO_3^-) also creates oxygen demand. Eutrophication, which is defined as excessive algal growth, can also lower the dissolved oxygen levels of surface waters. When a body of water becomes eutrophied, algae proliferate and deteriorate the appearance of previously clear waters. As the algae die, their decomposition consumes oxygen, creating a condition known as hypoxia. Hypoxia can damage aquatic life and cause fish kills if dissolved oxygen concentrations fall below a level that can support respiration. Nitrogen may also cause toxic effects in fish and other aquatic life if concentrations of ammonia-nitrogen (NH_3) in surface waters rise above toxic levels.

The regulation of nitrogen discharged to surface waters presents some technical challenges for the USEPA. The Clean Water Act of

1977 and the Water Quality Act of 1987 directed the USEPA and the states to classify all waters according to their designated uses and develop water quality criteria for pollutants which insure that the designated use of each water body will be realized. The impacts of nitrogen discharges on a receiving water tend to be site-specific. Therefore, the states rely on computer modeling evaluations and water quality studies specific to a water body to determine the effects of nitrogen on the system. These studies are used by permitting authorities to develop waste load allocations for nitrogen which describe the amount of nitrogen a receiving system can assimilate while still sustaining the designated use of the water body. Permit limitations are developed for dischargers to the system based on the results of the waste load allocation modeling. The quality of the data used to conduct the water quality studies and waste load allocation modeling can impact the final permit limitations which are imposed on point source dischargers to a receiving water.

During the 1970s the NJDEP attempted to classify all surface waters in New Jersey using a watershed approach which divided the state into regional water quality management districts. The BCUA, as a discharger to the lower Hackensack River, was incorporated into the Northeast Water Quality Management Plan which was drafted by the NJDEP in the late 1970s. This plan was developed to describe the effects of all pollutant sources, including industrial dischargers, power generating plants, storm water sources, combined sewer overflows, and wastewater treatment plants, on the water quality of the region. Field sampling and water quality modeling of the Hackensack River was conducted by the NJDEP during the development of the Northeast Water Quality Management Plan to address dissolved oxygen deficits caused by nitrogen discharges from point sources, including the BCUA. The study concluded that, among other mitigation strategies, stringent permit limitations for nitrogen should be imposed on the BCUA wastewater treatment plant effluent to insure acceptable dissolved oxygen levels in the lower Hackensack River. This conclusion had costly implications for the BCUA.

In the 1970s, a few events occurred within a short period of time which forced the BCUA to address nutrient issues. The Northeast Water Quality Management Plan, and its subsequent revisions adopted in the mid-1970s, defined the required effluent limitations for the BCUA as follows:

Biochemical Oxygen Demand (mg/l)	Ammonia (mg/l)	Suspended Solids (mg/l)	Dissolved Oxygen (mg/l)
16	4	16	6

During this period, the BCUA had agreed to provide sewer service to the Northern Valley and Pascack Valley municipalities to protect the Hackensack Water Company reservoirs from contamination caused by failing septic systems. The treatment plant subsequently had to be expanded to accommodate the increased flow. The Federal Water Pollution Control Act of 1972 provided funding for the construction, expansion and modernization of wastewater treatment plants, so the BCUA applied for grant money to expand the treatment plant from 50 mgd to 75 mgd. The USEPA approved the grant proposal, but attached a condition to the grant requiring the BCUA to evaluate:

> "higher levels of treatment versus the relocation of the existing outfall in order to meet applicable water quality standards and

> submit a completed facilities plan approvable to the NJDEP and the USEPA and then proceed to design and construct the necessary wastewater treatment works."

The "higher level of treatment" that the BCUA had to evaluate was advanced wastewater treatment that would enable the BCUA to meet the limitations included in the Northeast Water Quality Management Plan. While the BCUA questioned the technical validity of the limitations, the grant condition did not permit the BCUA to challenge or revisit these limitations. To satisfy the grant condition, the BCUA contracted Clinton Bogert Associates to study the costs and benefits associated with advanced wastewater treatment and outfall relocation. Clinton Bogert Associates determined that it would be more cost-effective for the BCUA to relocate the outfall to the Hudson River than to construct an advanced wastewater treatment plant. The recommendations were incorporated in the report entitled Additional Waste Treatment Facilities which was submitted to the NJDEP in 1984. The estimated cost for relocating the outfall to the Hudson River was approximately $50,000,000.

The NJDEP did not issue formal comments on the report. However, the NJDEP issued a major modification to the BCUA's NJPDES permit in 1985 which mandated that the BCUA comply with the Northeast Water Quality Management Plan. Because the expenditure required to construct an advanced wastewater treatment plant or to relocate the outfall to the Hudson River was so exorbitant, the BCUA adjudicated the permit and requested an opportunity to reevaluate the limitations. The BCUA and the NJDEP became parties to an Administrative Consent Order (ACO) which allowed the BCUA to perform a water quality study of the Hackensack River to reevaluate the limitations. The BCUA contracted Clinton Bogert Associates to conduct the field sampling and computer modeling necessary to develop appropriate limitations and to recommend the mitigation steps that would enable the BCUA to meet the regional water quality goals of the NJDEP. As specified in the ACO, the report entitled Impact Analysis of Sewage Treatment Plant Discharges on the Water Quality of the Lower Hackensack River was submitted to the NJDEP in 1990. The study concluded that relocation of the outfall to a point below the confluence of Berry's Creek would improve the water quality of the Hackensack River sufficiently and that advanced wastewater treatment or other mitigation was unwarranted. The NJDEP required some revisions to the report, and the response was provided in 1992.

The NJDEP issued a revised NJPDES permit to the BCUA in 1990. The ACO was incorporated into the permit as a permit condition, but by 1990, most of the milestones in the ACO had been fulfilled. The permit did not contain a numeric limitation for ammonia, despite the extensive study of the lower Hackensack River. The passage of the Water Quality Act of 1987 resulted in the development of the National Estuary Program, which has apparently superseded the NJDEP's nutrient program for the lower Hackensack River.

The National Estuary Program was established by the Water Quality Act of 1987 to promote long-term planning and management in nationally significant estuaries threatened by pollution, development or overuse. The states participating in the program must prepare comprehensive management plans for the regions which address pollution control, public education and pollution prevention. The goal of the program is to manage estuaries and the tributaries that drain into estuaries as one ecosystem. To accomplish the program goals, working partnerships are encouraged among federal, state and local governments, industry, public interest groups and the scientific community. The New York/New Jersey Harbor is one of the systems that has been included in the National Estuary Program. Point source dischargers to the waters and tributaries of the New York/New Jersey Harbor have recently begun to participate in some of the studies being conducted in this system.

The New York/New Jersey Harbor system includes the Hudson River, Passaic River, Hackensack River, East River, Harlem River, Raritan River, the Arthur Kill, the Kill Van Kull, Newark Bay, Jamaica Bay, New York Bay, Raritan Bay, and numerous smaller tributaries. Given the complexity of the region and the multi-jurisdictional political landscape, an array of regulatory agencies have coordinated their management efforts under the auspices of the New York/New Jersey Harbor Estuary Program (HEP). The goal of the HEP is to establish and maintain a productive ecosystem with full beneficial uses. The HEP has coordinated numerous studies to address toxic loadings and nutrient loadings to the New York/New Jersey Harbor from various sources, including wastewater treatment plants in both New York and New Jersey. Since the USEPA funding for these studies is limited, state and local agencies have been required to contribute to data collection and computer modeling efforts to support the HEP studies. Recently, the eleven wastewater treatment plants in New Jersey discharging to the waters and tributaries of the New York/New Jersey Harbor have been required to supplement data collection efforts for both toxics and nutrients. In response, the BCUA and the other New Jersey discharges formed a consortium known as the New Jersey Harbor Dischargers Group (NJHDG) to provide a unified and cost-effective approach to the studies required by the USEPA and the HEP.

During the 1980s, frequent shellfish harvesting bans and beach closings in the New York/New Jersey Harbor and New York Bight led to the formation of the New York Bight Restoration Program to study the water quality degradation occurring in the region due to pollution. A number of technical reports were produced which identified many major use impairments due to pollution. When the HEP was organized in the early 1990s, the New York Bight Restoration Program efforts were incorporated into the HEP comprehensive management program. The HEP used the previous studies as a baseline for examining water quality degradation in the region including one study which suggested that wastewater treatment plant discharges into the East River were resulting in hypoxia problems in the Long Island Sound. Studying the impacts of the New York City wastewater treatment plants on the water quality of the New York/New Jersey Harbor, the New York Bight and the Long Island Sound became a priority for the HEP.

The New York City Department of Environmental Protection (NYCDEP) is responsible for the operation of fourteen wastewater treatment plants located in New York City. The relationship between the New York City treatment plants and hypoxia in the New York/New Jersey Harbor and the Long Island Sound is a concern for the NYCDEP since mitigation strategies such as treatment plant upgrades, advanced wastewater treatment or outfall relocation require costly construction. To avoid the needless construction of new facilities, the NYCDEP is funding the development of a computer model for nutrients, referred to as the System-Wide Eutrophication Model (SWEM), which describes the interaction between nutrient loadings from various point and non-point sources and hypoxia throughout the New York/New Jersey Harbor, the New York Bight and the Long Island Sound. The NYCDEP intends to use the model as a long-term facilities planning tool to determine if nitrogen mitigation is necessary for the New York City treatment plants and to predict which mitigation options would prove most effective. The cost to the NYCDEP to develop the SWEM is approximately $20,000,000.

While the nutrient model has been funded almost entirely by the NYCDEP, the USEPA and the HEP are providing the regulatory oversight for the model development to insure that the conclusions drawn from the effort are technically sound. Furthermore, upon completion of the SWEM, the USEPA intends to utilize the model to develop waste load allocations for nutrients and calculate permit limitations for dischargers to the system. The NYCDEP has agreed to fund the collection of nutrient data needed to develop the model, including sampling of the ambient environment and the New York City wastewater treatment plant effluents. Based on a technical evaluation of the SWEM, however, the HEP has determined that data is also required from wastewater treatment plants discharging to the tributaries in New Jersey to properly estimate the loadings from these sources. Since data collection in New Jersey is outside the scope of responsibilities of the NYCDEP, the USEPA has intervened and is requiring that the dischargers in New Jersey supplement the NYCDEP data collection effort. Each of the eleven wastewater treatment plants in New Jersey which comprise the NJHDG received a 308 letter from USEPA in January 1995 directing the NJHDG members to supply nutrient data for the wastewater treatment plant effluents and the ambient environment in and around the New Jersey tributaries. A 308 letter is a demand for information from the USEPA which is allowed under Section 308 of the Clean Water Act of 1977. Failure to comply may result in enforcement action from the USEPA. The NJHDG is currently contracting the services necessary to provide the information.

When the SWEM is completed, the USEPA will use it to develop a waste load allocation for nitrogen for the New York/New Jersey Harbor. The waste load for nitrogen will then be allocated to the various point and non-point sources of nitrogen to the estuary. The allocation for the BCUA and the other wastewater treatment plants will be translated into NJPDES permit limitations for ammonia and possibly other forms of nitrogen. If the BCUA receives a stringent ammonia limitation in the next issuance of the NJPDES permit, some of the previous studies of advanced wastewater treatment versus outfall relocation may need to be revisited. It is in the best interests of the BCUA to monitor the activities of the HEP and participate in the studies when necessary to insure that the regulatory agencies at the state and federal level make informed and technically sound decisions regarding the impacts of wastewater treatment plant discharges on the New York/New Jersey Harbor system.

3.5.2 Infiltration and Inflow

Sanitary sewage flow has both a base and an infiltration/inflow (I/I) component. The base sewage flow consists of wastewater discharged to the collection system through building connections, such as residential flow, industrial wastewater flow, and flow from employment centers and commercial establishments. The I/I component originates as groundwater or surface runoff. Infiltration refers to groundwater that seeps into the sanitary sewer system through poorly sealed joints or cracks in sewers and manholes. Inflow is water discharged directly to sewer pipes from roof drains, yard drains, catch basins, cooling towers and other sources including storm water illegally diverted into sanitary sewers. While wet weather exacerbates the problem of extraneous flows, a significant portion of the BCUA's typical flow is contributed by groundwater seeping into the collection system through deteriorating pipes in areas that have a high water table.

The BCUA regional sewer system was designed with the capacity to convey and treat the sanitary wastewater flows from the member municipalities discharging or expected to discharge to the system. The system was not designed to convey and treat exceptionally high rates of I/I. Several times each year, generally during and after severe wet weather events, excessive I/I is admitted by the municipal sanitary sewer systems. During peak wet weather periods, the I/I flows are four to five times higher than the normal base sanitary wastewater flow. These excessive I/I flows overload the BCUA sewers and treatment facilities and result in the discharge of untreated wastewater to the area surface waters through overflows, which are designated discharge points for untreated wastewater.

With the passage of the Federal Water Pollution Control Act of 1972, the USEPA began to address the environmental and engineering problems caused by excessive extraneous flows entering a sanitary system. Wet weather induced I/I creates peak flows many times higher than normal base flows which frequently results in the overflow of untreated sewage into surface waters or the backup of sewage into building connections from pipes that do not have the capacity to convey extraneous flows. The Act established a grant program for the upgrade and expansion of wastewater treatment plants. As part of the program, funds were also administered for the evaluation and mitigation of I/I. The USEPA recognized that in some systems treatment plant expansions might not be the most cost-effective approach to treating peak flows.

The BCUA treatment plant expansion constructed in 1977 to increase the treatment capacity from 50 mgd to 75 mgd was funded largely with grants provided by the USEPA. As discussed previously, the USEPA attached conditions to the grants which required the BCUA to address various issues. One of the grant conditions necessitated that the BCUA study the extent of the I/I entering the BCUA system and determine the cost-effectiveness of remediation. The BCUA contracted Clinton Bogert Associates to perform an I/I study in each municipality served by the BCUA. The report Infiltration/Inflow Analysis and Sewer System Evaluation Report which quantified the I/I discharged by each municipality was submitted to the USEPA in 1981. An analysis of the cost and benefits associated with reducing I/I in each municipality was provided in the report Sewer System Evaluation Flow Isolation Report. This report, submitted to the USEPA in 1984, concluded that the cost to the BCUA of significantly reducing I/I exceeded the cost of constructing new facilities. However, the report recommended that municipalities with high rates of I/I mitigate wet weather induced I/I to reduce user charge fees. Very little work was performed by the municipalities to reduce I/I.

The BCUA operates four wastewater overflows in the collection system and two overflows within the treatment plant. Each overflow is assigned a specific discharge number by the NJDEP and is regulated by the NJPDES permit issued to the BCUA. The overflows listed in the permit are as follows:

#002-	Untreated wastewater discharge point at the BCUA treatment plant.
#003-	Untreated wastewater discharge point at the BCUA treatment plant.
#004-	Overflow located at New Bridge Road in Teaneck.
#005-	Overflow located on the Overpeck Valley Trunk Sewer in Englewood.
#006-	Overflow located on the Overpeck Valley Trunk Sewer in Englewood.
#007-	Overflow located at Pink Street Pumping Station in Hackensack.

In 1990, the NJDEP modified the BCUA's permit to prohibit the use of these overflows. While some of the overflows could be removed from service relatively easily, the directive to close all overflows immediately was a potential threat to the effective operation of the treatment plant. The BCUA adjudicated this permit provision and subsequently entered an Administrative Consent Order (ACO) with the NJDEP on December 17, 1991 to systematically eliminate the overflows.

As part of the ACO, remediations were designed for overflows #004-

007 located in the collection system. Some construction has already been initiated to eliminate these overflows at discharge points #005 and #007. Overflow #002 located at the BCUA treatment plant has been sealed and is recognized as a closed overflow point by the NJDEP. Remediation of the remaining upstream overflows at discharge points #004 and #006 can only be accomplished at great cost. Furthermore, the closure of the upstream overflows will exaggerate the frequency and magnitude of the overflows expected to occur at the wastewater treatment plant at discharge point #003 since these previously bypassed flows would now reach the treatment plant in Little Ferry.

The ACO does not yet contain a deadline for the elimination of the overflows. However, the ACO contains milestone dates by which certain study phases must be completed, with the expectation that the studies will lead to a definite schedule for the overflow closures. The remediation of the four upstream overflows will impact overflow #003 at the wastewater treatment plant. Therefore, the closure of the overflow #003 can only be accomplished by constructing a major plant expansion to treat the previously bypassed flow, or by significantly reducing the amount of I/I entering the aging sewer system.

According to the NJDEP, the elimination of the overflows in the collection system and at the treatment plant is the only acceptable endpoint of the ACO. The approach chosen to achieve the elimination of the overflows remains open to negotiation between the NJDEP and the BCUA. If it is determined that reducing I/I is the more cost-effective means of eliminating the overflows, some consideration must be given to the funding of this work, as federal grants for I/I reduction projects are no longer available. The member municipalities discharging to the BCUA own and maintain responsibility for their collection systems. Previous studies have indicated that many municipalities could significantly reduce user charge fees to the BCUA by rehabilitating aging sewers, but very few municipalities have voluntarily performed I/I reduction work. Therefore, if I/I reduction is mandated by the ACO, the BCUA will be forced to perform the sewer system remediation work within the municipal collection systems.

The older sewer systems in the BCUA service area have the highest rates of I/I. Therefore, the sewer systems in municipalities such as Teaneck and Englewood would be I/I reduction priorities, whereas, the newer systems in the Northern Valley municipalities would be low I/I reduction priorities. If the BCUA funds I/I reduction projects in a few municipalities through the user charges assessed from all the municipalities, the argument could be made that some municipalities are being required to subsidize other municipalities. Furthermore, remediating I/I in some areas will reduce the flows metered in the sewer system, which will reduce the user charges assessed to that municipality. The reduction of user charges to some municipalities will shift the burden to the other municipalities, which may be seen as unfair funding practice by the BCUA. While the final overflow elimination program has not yet been incorporated into the ACO, the funding of I/I projects warrants consideration.

3.5.3 Combined Sewer Overflows

A combined sewer is a wastewater collection system which conveys sanitary wastewater and storm water through a single pipe to a wastewater treatment plant. During dry weather, combined sewers carry wastewater to treatment facilities. However, during storm events, combined sewers may not have the capacity to convey the increased flows to wastewater treatment plants, and the wastewater is discharged untreated into surface waters, thus creating a combined sewer overflow (CSO).

The untreated domestic waste discharged through CSOs often contains high levels of BOD, solids and pathogens. CSOs may also contain toxic pollutants, such as metals, pesticides and petroleum products from untreated industrial wastewater and urban storm water runoff. Under the provisions of the Clean Water Act of 1977, CSOs are regarded as point sources of pollution and must be issued individual control permits by the delegated permitting authority. Since the pollutants discharged through CSOs have the potential to degrade the surface waters receiving CSOs, the USEPA has established a national program for CSO abatement. The primary objective of the national CSO program is to meet water quality standards and achieve the designated uses of surface waters by eliminating, relocating or controlling CSOs that result in violations of these standards.

Of the forty-six municipalities served by the BCUA, Fort Lee, Hackensack and Ridgefield Park contain combined sewer systems. The collection system within each municipality is owned and operated by the municipality. Therefore, the BCUA does not bear the responsibility for materials discharged directly to the surface waters of these municipalities through CSOs. The NJDEP currently regulates CSOs through the issuance of NJPDES permits to the municipalities that operate CSOs. However, the complexity and expense of CSO mitigation has become burdensome for municipalities. It is possible that the regional sewerage authorities in New Jersey may be delegated the responsibility of managing CSOs in the future.

Municipalities that operate CSOs must demonstrate compliance with minimum control standards. These minimum controls include the prohibition of overflows during dry weather, the maximization of flow discharged to wastewater treatment plants, the control of solid and floatable materials in CSOs and the implementation of a monitoring program to evaluate CSO impacts on receiving waters. If the CSO outfall in a particular location results in the failure of a receiving water to meet water quality standards, the mitigation requirements become more stringent. Even complying with the minimum controls requires extensive and, therefore, costly, study. In New Jersey, the Sewage Infrastructure Improvement Act grant program administered through the State Revolving Fund can provide for up to 90% of the cost of CSO management projects, but most of the monies available are distributed as loans.

If the BCUA becomes the delegated authority responsible for CSO management and abatement, a decision needs to be made regarding an appropriate mechanism for the funding of this work. Since the CSOs in the BCUA service area are located in only three municipalities, the BCUA may either choose to assess the costs directly from the municipalities in which the CSOs are located or distribute the burden evenly among all the municipalities served by the BCUA. Both of these options have advantages and disadvantages. While the BCUA is not yet responsible for CSOs, these issues warrant some consideration.

3.6 Other Regulations

The BCUA must comply with numerous other regulatory programs that are not directly related to water pollution control. A description of some of the more burdensome regulatory programs is provided.

3.6.1 Toxic Catastrophe and Prevention Act

The New Jersey Toxic Catastrophe and Prevention Act (TCPA) requires that owners or operators of facilities that generate, manufacture, store, handle, or use certain extremely hazardous substances develop and implement sound management programs to protect against a catastrophe resulting from an accidental release of the hazardous substances. Chlorine is one of the extremely hazardous substances listed in the TCPA. Since the BCUA uses liquid chlorine as a wastewater disinfectant, up to fifty one-ton containers of liquid chlorine may be stored on the premises at any time. Therefore, the BCUA must comply with the TCPA regulations.

Pursuant to the TCPA, the BCUA has developed a comprehensive risk management program for chlorine use and handling. The program includes implementation of a detailed standard operating procedure for chlorination, adherence to a preventive maintenance program for chlorination equipment and performance of an annual safety review. Extensive written procedures and records must be maintained for all elements of the risk management program in conformance with the TCPA record-keeping and reporting requirements. The BCUA is also required to institute a training program to teach BCUA personnel about the hazards of chlorine and the emergency procedures which must be followed in the event of an accidental release. The BCUA has appointed an Emergency Response Team to coordinate all emergency response activities, including communication with the local police, fire, rescue and first aid squads. Emergency response drills are conducted at least four times per year to train both employees and the Emergency Response Team.

Maintaining an appropriate risk management program and complying with the numerous TCPA requirements is labor intensive and costly. Furthermore, the liability associated with an actual chlorine accident is extraordinary. For this reason, the BCUA is considering the elimination of chlorine use for disinfection. The use of ultraviolet radiation for wastewater disinfection is becoming more common in the water pollution control industry as discussed previously in this report. However, the use of ultraviolet radiation would require costly construction and an increase in annual energy costs. The costs and benefits associated with the use of ultraviolet radiation versus chlorine for disinfection are under consideration by the BCUA.

3.6.2 Clean Air Act

The passage of the Clean Air Act of 1970 resulted in the establishment of air quality standards for the following six criteria pollutants:

1. Sulfur Dioxide
2. Nitrogen Dioxide
3. Ozone
4. Carbon Monoxide
5. Lead
6. Particulates

The USEPA refers to each of these air contaminants as "criteria" pollutants because numerical criteria were developed which describe the thresholds of protection for public health and welfare. The USEPA estimated the existing level of these pollutants in regions, or air basins, around the country. If a basin was found to have concentration levels above the established air quality standards, then the area was designated as a "non--attainment basin" for that pollutant. New Jersey is located within a non-attainment basin for ozone.

Among the provisions of the Clean Air Act of 1970 was the requirement that all stationary sources of the criteria pollutants, such as factory smoke stacks, be issued permits to regulate the amount of pollution emitted to the atmosphere. If an industry or facility has more than one air pollution source on its premises, each individual source is issued an emissions permit. The BCUA has numerous stationary sources of air pollution at the wastewater treatment facility in Little Ferry and has been issued approximately 20 air pollution emissions permits. These sources include the boilers, the methane flares on the anaerobic digesters, and the air pollution control devices on the recently constructed Sludge Dewatering Facility and Chemical Stabilization Facility. These permits contain specific monitoring and reporting requirements which must be carried out by the BCUA.

The passage of the 1990 Clean Air Act Amendments has forced the BCUA to address some previously unforeseen air pollution issues. This new legislation requires that states located within non-attainment basins for criteria pollutants mitigate the pollution problem or face strict federal sanctions, such as the loss of federal highway construction funds. New Jersey, as one of the states classified as non-attainment for ozone, has been forced to address not only air pollution from stationary sources, but also the pollution from automobiles. The state legislature passed the New Jersey Traffic Congestion and Air Pollution Control Act in 1992 which mandates that employers with more than 100 employees, including the BCUA, institute an Employee Trip Reduction Program (ETRP) to reduce the amount of commuter traffic clogging the roads and polluting the atmosphere. The BCUA is currently developing an ETRP which may include incentives for car pooling, such as transportation allowances, or a flexible work schedule that allows certain staff to work longer hours per day for fewer days a week. A good faith effort must be made by the BCUA to achieve the ETRP goals or fines and penalties maybe imposed by the state.

Another provision of the Clean Air Act Amendments of 1990 which may affect the operation of the BCUA wastewater treatment plant in the future is the establishment of a regulatory program by the USEPA to control and reduce emissions of hazardous air pollutants. This program is intended to reduce the exposure of the public to toxic air pollutants which have the potential to cause health problems, particularly cancer. Previous federal air pollution control regulations addressed only seven air toxics. Routine emissions of 189 toxic pollutants are regulated under the new program. The regulations direct states to identify major sources of air toxics, which are defined as facilities that emit more than 10 tons per year of a single listed compound or 25 tons per year of a combination of compounds. Facilities identified as major sources must install the maximum available control technology specified by the USEPA as the standard for the industrial category.

The USEPA has identified municipal wastewater treatment facilities as a potential source of hazardous air pollutants. Many treatment facilities receive discharge from industries and commercial establishments that may contain compounds appearing on the list of hazardous air pollutants. These compounds may volatilize as the wastewater is mixed and aerated during secondary treatment. While it is unlikely that the secondary aeration tanks and other unit processes at the BCUA wastewater treatment facility are emitting hazardous air pollutants above the major source threshold levels, the USEPA and the NJDEP may use conservative estimates of air emissions to determine if the BCUA should be categorized as a major source. Classification as a major source would require the BCUA to utilize maximum available control technology. This may include control of pollutants discharged to the wastewater treatment plant through the Industrial Pretreatment Program, but could also require new construction such as covers or air pollution control devices for the secondary aeration tanks. The BCUA will continue to monitor these issues and take appropriate steps to implement necessary programs.

4.0 Personnel

The BCUA employs a highly skilled work force to carry out the complex functions required to operate the wastewater treatment plant and insure compliance with all state and federal regulations. The staff of the BCUA's Water Pollution Control Division is organized into the seven major departments listed below:

- Engineering
- Plant Operations
- Plant Maintenance
- Field Operations
- Industrial Waste Control
- Laboratory
- User Charge

Engineering Department - The Engineering Department staff consists of a multi-disciplined work force of civil, environmental, mechanical and electrical engineers who handle the routine engineering necessary to maintain the BCUA's treatment plant and collection system. Their responsibilities include the design of modifications and alterations to the facilities, the management of construction projects, the writing and issuance of Requests for Proposals, the overseeing of consulting engineers, and the procurement of major purchases through the bidding process. They also serve as an internal resource for other departments requiring technical assistance.

Plant Operations Department - The Plant Operations Department staff manages the operation of the equipment and facilities necessary to provide effective wastewater treatment and to achieve consistent compliance with the NJPDES permit effluent limitations. Operating personnel are present 24 hours per day, seven days per week. The staff works on eight hour shifts, and each shift requires the attendance of four operators; an assistant chief sewage plant operator, a senior sewage plant operator, a sewage plant operator and a sludge plant operator. If the sludge dewatering and chemical stabilization facilities are in operation, another sludge plant operator and sewage plant attendant/weighmaster will also be present. Covering each of these positions 24 hours per day necessitates that six personnel be assigned to each job title.

The operations staff is divided into three functional groups, designated as head end, tanks and sludge. The head end operations group controls the main sewage pumps, the blowers, the boilers and the emergency generators. Their main functions are to guarantee the pumping of the sewage and to insure the constant supply of air, power and heat necessary to support the treatment process. The tanks operations group operates the primary settling tanks, the secondary aeration tanks and the final settling tanks. This group is responsible for monitoring the wastewater treatment process to remove the BOD and the suspended solids in the sewage and to achieve compliance with the NJPDES permit. The tank operators control the process factors that allow for the efficient treatment of the sewage. They are also responsible for the pumping of primary and waste activated sludge from the primary settling tanks and the final settling tanks. The sludge group operates the thickening, digestion, dewatering and chemical stabilization of the sludge. This group controls the processes necessary to process the sludge from a potential human health and environmental hazard to a beneficial use product safe for ultimate disposal. The sludge processes must be carefully monitored to efficiently and effectively meet the standards for beneficial reuse.

Plant Maintenance Department- The treatment plant maintenance staff maintains and repairs the equipment so that the operations department has sufficient resources to treat the sewage. The maintenance department consists of subgroups designated as the machine shop, welding shop, buildings and grounds, heavy maintenance, vehicle shop, electrical and chlorination. The BCUA maintenance personnel are capable of servicing and maintaining a wide range of equipment such as turbines, generators, pumps, compressors, gear boxes, fans, chillers, mixers, high voltage electrical switchgears and electronic equipment. The BCUA is capable of doing almost all maintenance in-house. This self-sufficiency is necessary to guarantee the continuous operation of the equipment and the treatment of the sewage to meet the NJPDES permit.

Field Operations Department- The field operations staff maintains the wastewater collection system, the pumping stations and the flow meters outside of the treatment facility. Field personnel operate the Vactor Truck, which is used to clean large diameter sewer lines, and the TV Trailer, which is used to inspect the sewer lines. They also maintain the pumps, the electrical equipment and the generators in the pumping stations. They clean the pumping station wet wells periodically of grit and other debris. They also calibrate and maintain the meters used to measure the flow from the member municipalities.

Industrial Waste Control Department - The Industrial Waste Control Department administers the Industrial Pretreatment Program. The staff is comprised of personnel trained in the various aspects of program implementation and administration. Their responsibilities include the issuance of permits to industrial wastewater dischargers, the monitoring and inspection of permitted industries to verify compliance with permit limitations, and the initiation of enforcement actions as required to prevent industrial user violations. The Industrial Waste Control Department staff performs the technical evaluations necessary to establish local discharge limitations to meet regulatory requirements such as sludge criteria. This department manages a Pollution Prevention Program that advises industries on waste minimization, and has developed an in-house waste minimization program. Other tasks assigned to this department include the management of the BCUA's NJPDES permit, air pollution permits, underground storage tank permits, and stormwater permits, and all sludge quality reporting required to comply with state and federal sludge programs.

Laboratory Department- The laboratory conducts the sampling and testing necessary to control the treatment plant processes, calculate the user charges for the member municipalities, monitor the discharge of pollutants from industrial permittees, and fulfill the monitoring and reporting requirements for NJPDES permit compliance. The laboratory is certified by the NJDEP to the perform the analyses listed in Table 4-1. Approximately 162,000 analyses are completed each year by the BCUA's laboratory. The equipment used in the laboratory includes an atomic adsorption spectrophotometer for metals analyses, a gas chromatographer/mass spectrophotometer for organic compound analyses, a Microtox unit, and a total organic carbon analyzer.

User Charge Department- The user charge group collects and analyzes the data that is needed to calculate the annual charges to member municipalities. This includes the weekly analysis of the 166 charts recovered from the collection system flow meters and the BOD and suspended solids data obtained by the laboratory. The data is compiled throughout the year, and at the end of the year the user charges are calculated.

A breakdown of the current number of employees in each of the seven departments is provided in Table 4-2.

Bergen County Utilities Authority
Water Pollution Control Division

Table 4-1

BCUA's Laboratory Certified Parameters

Microbiology

Fecal Coliform
Enterococci
Pseudomonas Aeruginosa*
Total Coliform
Heterotrophic Plate Count*

Limited Chemistry

Temperature
Turbidity
Specific Conductance
Dissolved Oxygen-Winkler Method
COD
Hydrogen Ion (pH)*
Acidity
Total Volatile Solids
Settable Solids-Volumetric
Organic Nitrogen
Nitrite
Nitrate
Orthophosphate as P
Total Cyanide
Sulfide
Chloride
Total Fluoride
Hexavalent Chromium
Surfactants
Total Dissolved Solids
Temperature, Continuous Monitor*
Color
Dissolved Oxygen-Electrode Method
BOD(5 days and 20 days)
Hydrogen Ion-pH
Alkalinity
Total Solids
Suspended Solids
Oil and Grease
Ammonia Nitrogen
Total Kjeldahl Nitrogen
Phosphorus, Total as P
Total Organic Carbon

Hardness
Sulfate
Silica
Phenols
Chlorine Residual

Metals

Calcium (ICAP)*
Magnesium (ICAP)*
Sodium (ICAP)
Potassium (ICAP)*
Arsenic (ICAP)
Barium (ICAP)
Beryllium (ICAP)
Calcium (AA)
Magnesium (AA)
Sodium (AA)
Potassium (AA)
Arsenic (AA/GF)
Barium (AA/GF)
Beryllium (AA/GF)

Table 4-1 (Continued)

BCUA's Laboratory Certified Parameters

Cadmium (ICAP)
Chromium (ICAP)
Cobalt (ICAP)

Cadmium (AA/GF)
Chromium (AA/GF)
Copper (ICAP)

Copper (AA/GF)
Iron (AA/GF)
Lead (AA/GF)
Manganese (AA/GF)
Thallium (AA/GF)
Molybdenum (AA/GF)
Nickel (AA/GF)
Silver (AA/GF)
Vanadium (AA/GF)
Zinc (AA/GF)
Antimony (AA/GF)
Aluminum (ICAP)
Selenium (AA/GF)

Iron (ICAP)
Lead (ICAP)
Manganese (ICAP)
Thallium (ICAP)
Molybdenum (ICAP)
Nickel (ICAP)
Silver (ICAP)
Vanadium (ICAP)
Zinc (ICAP)
Antimony (ICAP)
Tin (ICAP)
Aluminum (AA/GF)
Mercury (Cold Vapor)

Organics

Pesticides & PCBS (GC)
Base Neutrals, Acids & Pesticides (GC/MS)
Chlorinated Hydrocarbons (GC)

* The BCUA has applied for certification for this parameter.

Bergen County Utilities Authority
Water Pollution Control Division

Table 4-2

Current Number of Employees

	Management/Technical	Supervision	Workers
Engineering	10	-	3
Operations	1	11	34
Maintenance	1	8	74
Field Operations	1	5	41
Industrial Waste	4	-	5
Laboratory	3	2	24
User Charge	-	1	5
Total	20	27	186

5.0 Budget

The BCUA must develop an annual budget that is sufficient to carry out the statutory and regulatory requirements under which it must operate. The rates developed by the User Charge Department must be adequate to fully fund the budget. The Water Pollution Control Division staff prepares the budget, and it is subsequently reviewed, modified and approved by the BCUA's Board of Commissioners. The budget must be presented to the public for review at a public hearing prior to final adoption by the Board of Commissioners. The budget must also be submitted to the New Jersey Department of Community Affairs, Division of Local Government Services for review and approval.

The three major components of the Water Pollution Control Division budget are allocated administrative expenses, operating expenses and debt service.

Allocated Administrative Expenses - Allocated Administrative Expenses consist of the Water Pollution Control Division's share of the administrative costs incurred by the BCUA. These administrative costs include the salaries and benefits paid to the Board of Commissioners, the executive director, the chief fiscal officer, data processing personnel, and purchasing, finance and administrative services staff. Other costs include the purchase of computers, office supplies, mailings, and security. In 1995, the Water Pollution Control Division is responsible for 52.4%, or $3,532,249 of the Allocated Administrative Expenses budget.

Operating Expenses - The Operating Expenses portion of the budget includes all expenses necessary to operate and maintain the wastewater treatment plant facilities. Table 5-1 is a summary of the 1995 budget for the Water Pollution Control Division. The total operating expenses budget for 1995 are $32,457,781, of which $16,101,081 is allocated for personnel costs and $16,356,700 is allocated for other operating expenses.

Bergen County Utilities Authority

Water Pollution Control Division

Table 5-1

1995 WATER POLLUTION CONTROL DIVISION BUDGET

1995 Budget

Allocated Administration	3,532,249
Operating	32,457,781
Debt Service	15,048,154
Total	51,038,184

Operating Budget

Personnel Costs

Department	Manage/Tech	Supervisor	Union	Total
Engineering	647,622	--	173,982	821,604
User Charge	--	71,395	225,336	296,731
Field	62,027	337,108	1,586,553	1,985,688
Laboratory	140,563	143,519	1,231,629	1,515,711
IWC	206,761	--	346,256	553,017
Operations	70,205	826,703	1,634,261	2,531,169
Maintenance	87,491	579,169	3,820,486	4,487,146
Benefits				3,910,015
Total Personnel	1,267,713	1,957,894	8,965,459	16,101,081

Non-Personnel Costs

Professional Services

Consulting Engineer	1,550,000
Legal	260,000
	1,810,000

Table 5-1 (Continued)

1995 WATER POLLUTION CONTROL DIVISION BUDGET

Other Expenses	
Training	15,000
Water	100,000
Telephone	85,000
Safety & Uniforms	275,000
Permits	525,000
Technical Operations	165,000
Insurance	521,200
Safety Vehicle	80,000
	1,766,200
Operations	
Electric	2,850,000
Oil & Natural Gas	80,000
Chlorine	230,000
Polymers	775,000
Lime	1,700,000
Ferric Chloride	150,000
Potassium Permanganate	200,000
Sludge Disposal	4,000,000
Solid Waste Disposal	330,000
Chemical Waste Disposal	15,000
	10,330,000
Maintenance	
Outside Services	100,000
Parts and Supplies	1,411,500
Auto and New Vehicles	177,000
	1,688,500
Field	
Electric	238,000
Parts and Supplies	119,000
Hydrogen Peroxide	75,000
	432,000

Table 5-1 (Continued)

1995 WATER POLLUTION CONTROL DIVISION BUDGET

Laboratory	
Outside Analysis	135,000
Supplies	195,000
	330,000
Total Non-Personnel	16,356,700
Total Operating	32,457,781

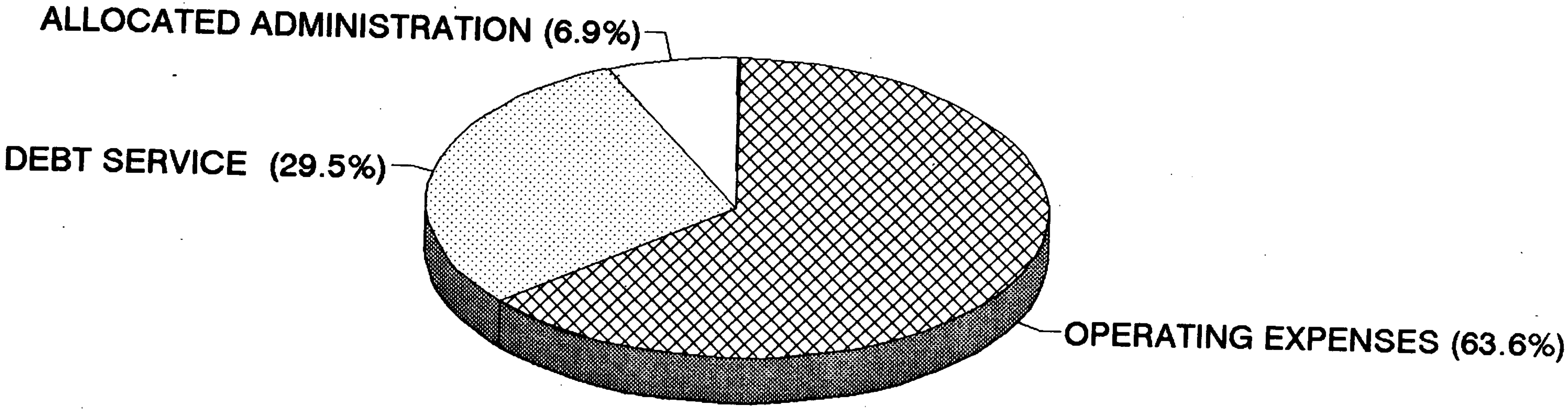
Debt Service - The debt service portion of the budget covers the expenses necessary to reimburse the bond holders for the principal and interest on the Water Pollution Control Division's debt. The debt service for 1995 is $15,048,154.

The 1995 Water Pollution Control Division budget is depicted in Figures 5-1 through 5-11. The three major budget components are illustrated in Figure 5-1, and a detailed total budget is illustrated in Figure 5-2. The operating expenses budget is depicted in Figure 5-3. Figures 5-4 and 5-5 present the total personnel costs and the total non-personnel costs, respectively. The individual department budgets for the Operations Department, Maintenance Department, Field Operations Department, and Laboratory Department are presented in Figures 5-6 through 5-9. Also depicted is the breakdown of the numbers of employees in each department in Figure 5-10, and a breakdown of the personnel costs by personnel category in Figure 5-11.

Table 5-2 presents a summary of the revenues collected to cover the 1995 budget. A review of this information reveals that most of the Water Pollution Control Division costs are recovered from user charges.

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

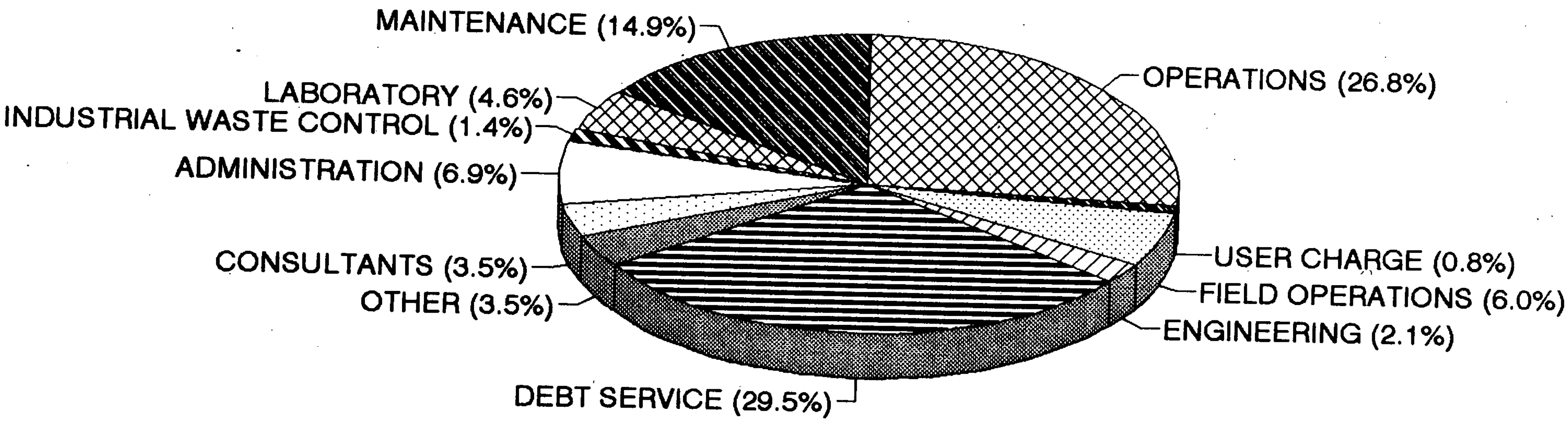
FIGURE 5-1
OVERALL BUDGET



TOTAL BUDGET = $51,038,184

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

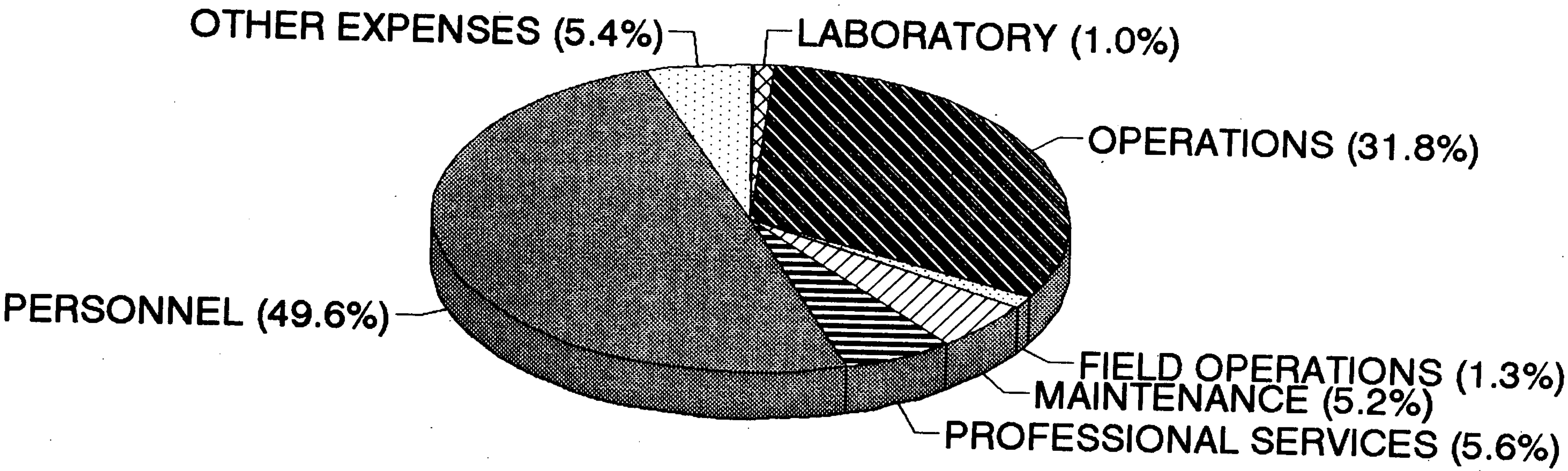
FIGURE 5-2
TOTAL BUDGET



TOTAL BUDGET = $51,038,184

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

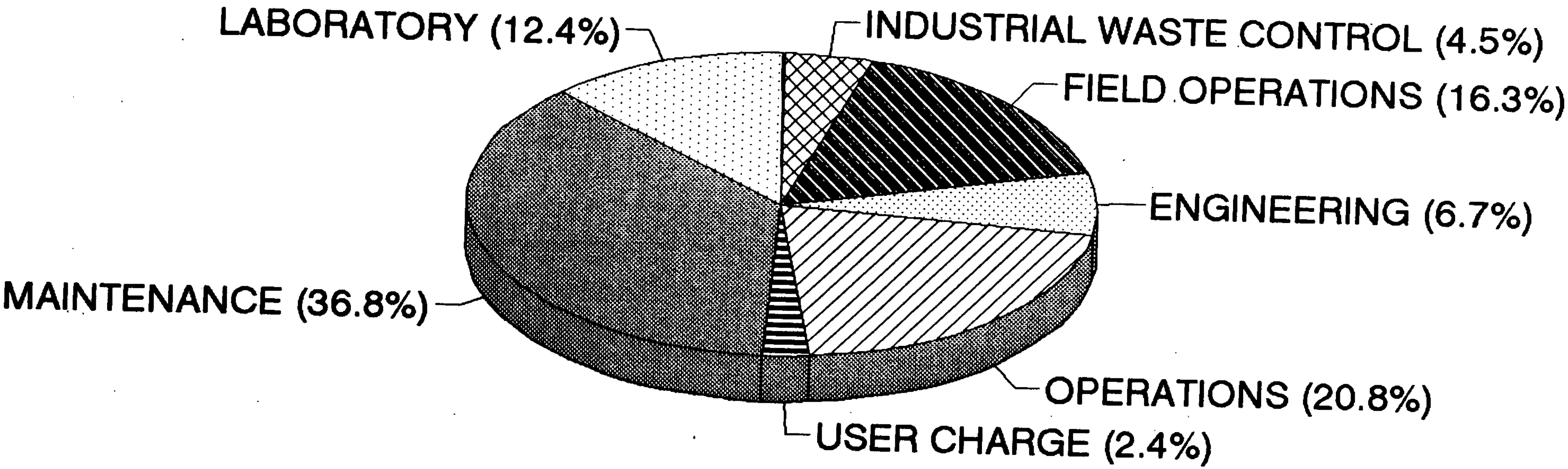
FIGURE 5-3
TOTAL OPERATING BUDGET



TOTAL OPERATING COSTS = $32,457,781

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

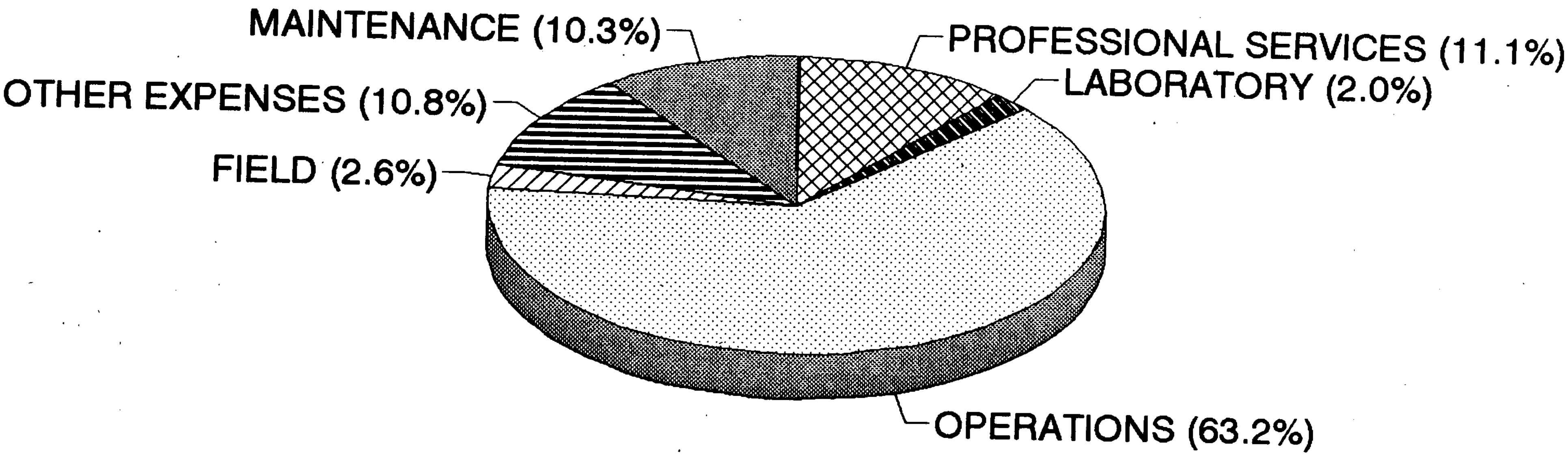
FIGURE 5-4
TOTAL PERSONNEL COSTS



PERSONNEL COSTS = $16,101,081

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

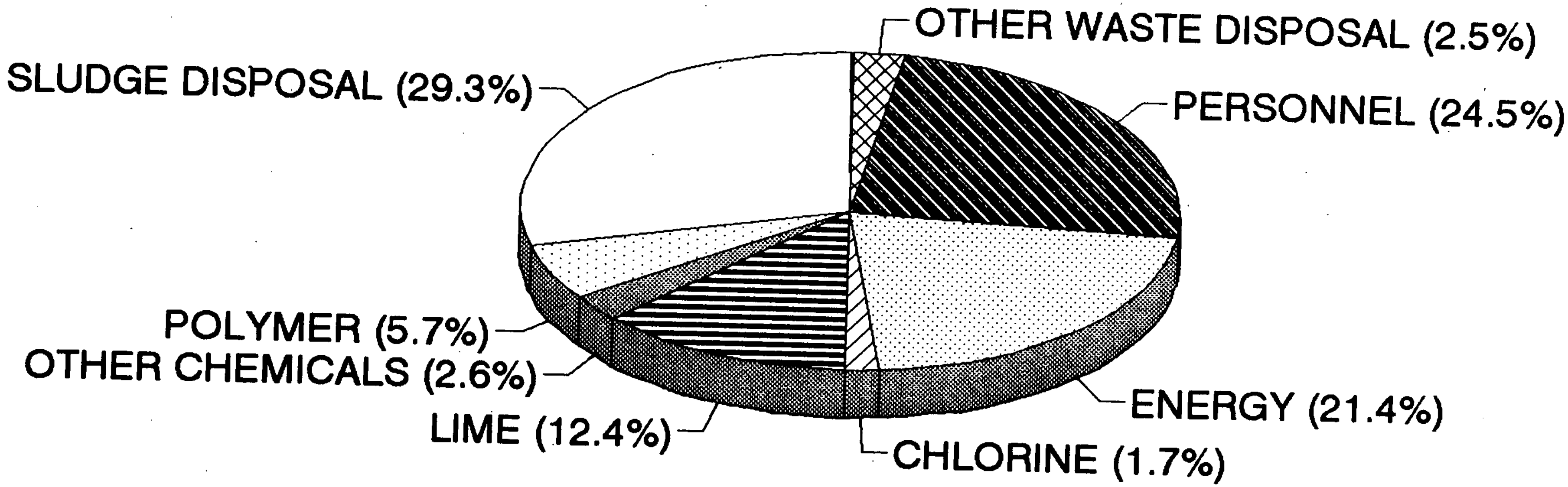
FIGURE 5-5
TOTAL NON-PERSONNEL COSTS



NON-PERSONNEL COSTS = $16,356,700

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

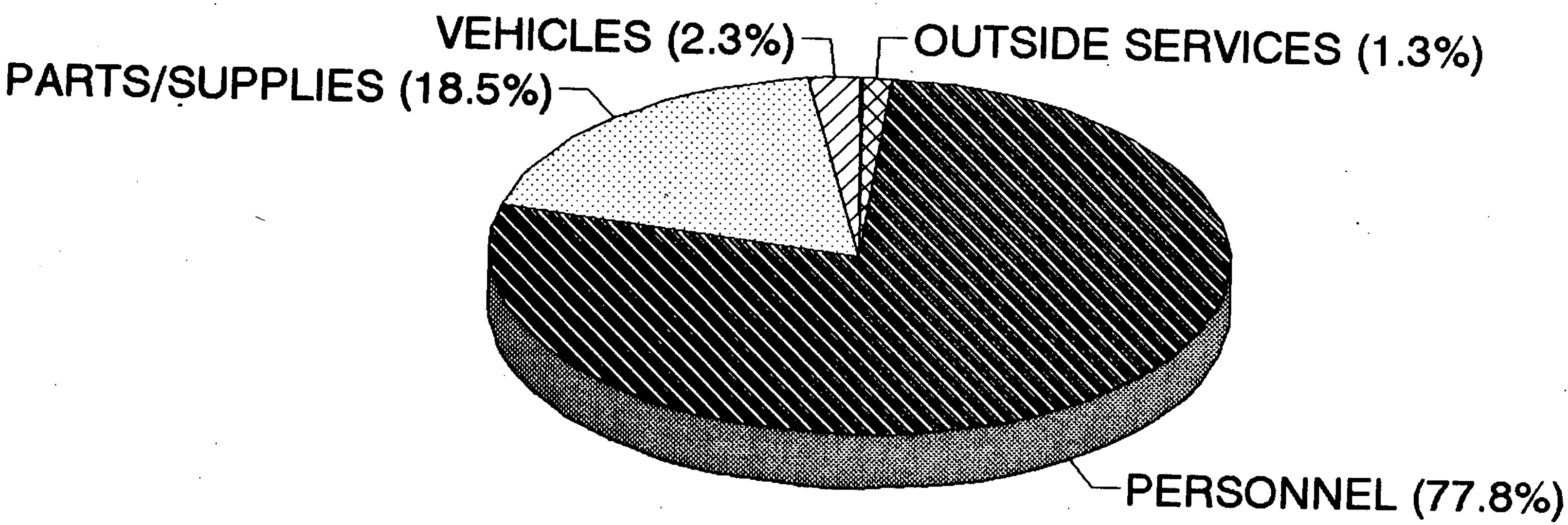
FIGURE 5-6
OPERATIONS DEPARTMENT BUDGET



TOTAL OPERATIONS COSTS = $13,674,452

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

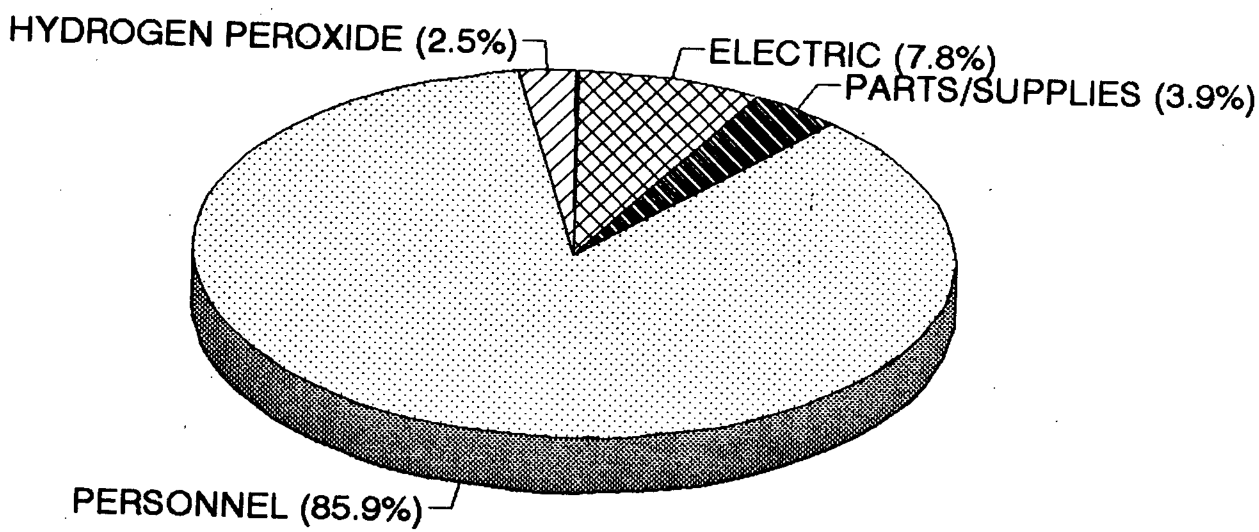
FIGURE 5-7
MAINTENANCE DEPARTMENT



TOTAL MAINTENANCE COSTS = $7,614,532

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

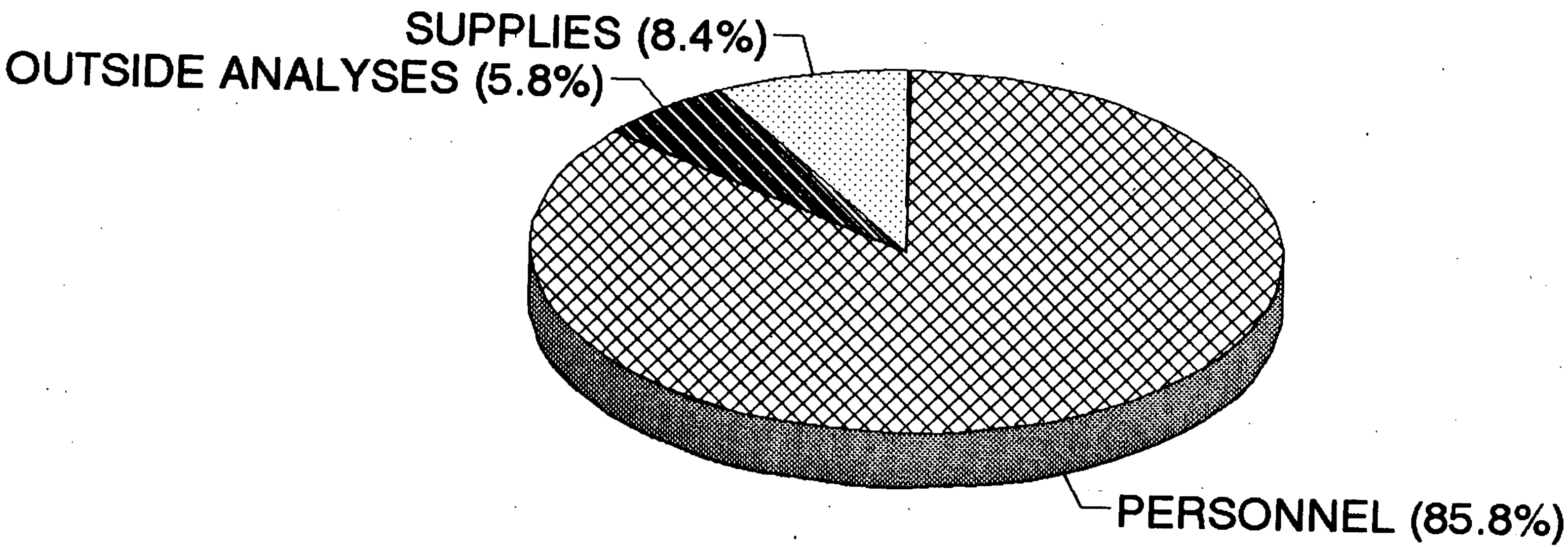
FIGURE 5-8
FIELD OPERATIONS DEPARTMENT BUDGET



TOTAL FIELD OPERATIONS COSTS = $3,055,020

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

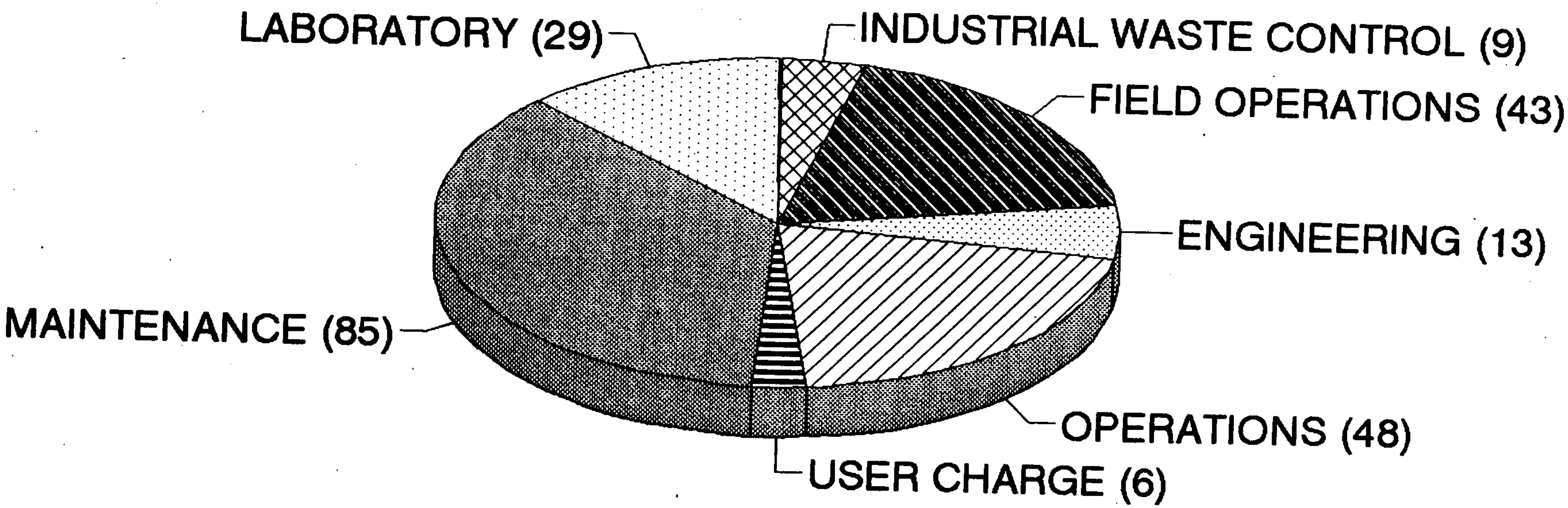
FIGURE 5-9
TOTAL LABORATORY DEPARTMENT BUDGET



TOTAL LABORATORY COSTS = $2,330,553

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

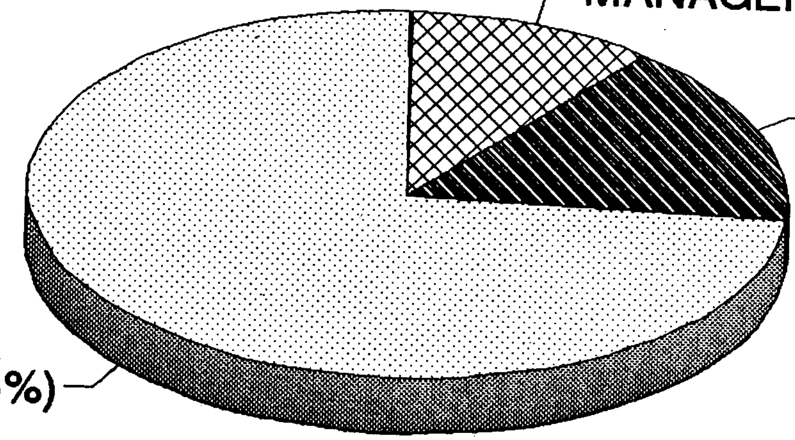
FIGURE 5-10
NUMBERS OF WORKERS



TOTAL NUMBER OF WORKERS = 233

BERGEN COUNTY UTILITIES AUTHORITY
1995 WATER POLLUTION CONTROL BUDGET

FIGURE 5-11
PERSONNEL CATEGORIES



PERSONNEL COSTS = $16,101,081

Table 5-2

1995 WATER POLLUTION CONTROL DIVISION REVENUE

User Charges	$48,287,646
Retained Earnings	$2,000,000
Other Operating Revenues	$600,000
Non-Operating Revenues	$150,538
Total	$51,038,184

6.0 User Charge System

6.1 Introduction

The BCUA's User Charge System consists of two components. The first component, referred to as Tier I, is a system for collecting the charges necessary to fund the BCUA budget. The second component, referred to as Tier II, is intended to notify users of the system of the proportion of their taxes that funds user charges.

6.2 Tier I User Chargers

The BCUA's Tier I User Charge System develops the rates and charges that each user of the system must pay to fund the BCUA's annual budget. The BCUA does not directly charge individual residences, commercial establishments or industries for sewer user charges. Instead, the BCUA charges the member municipalities who in turn assess the charges from their users in the municipalities. Most member municipalities collect these charges through municipal taxes, although a few municipalities such as Paramus, South Hackensack, Moonachie and Emerson have separate sewer charges. Some large industries that are connected to the BCUA system are directly billed by the BCUA. There are also a number of small commercial establishments connected to the BCUA system which are billed directly by the BCUA or whose flow is added to the total flow of the municipality in which they are located. The BCUA serves 46 municipalities, 2 municipal sewerage authorities, 4 industries and 17 direct billing customers. Collectively, all users of the system are known as subscribers. Table 6.1 lists the user charges assessed for all subscribers in 1995.

Bergen County Utilities Authority
Water Pollution Control Division

Table 6-1

1995 Service Fees

Subscriber	1995
Bergenfield	$1,941,907.84
Bogota	$528,623.34
Carlstadt	$637,661.77
Carlstadt S.A.	$485,801.21
Cliffside Park	$305,384.37
Closter	$635,222.06
Cresskill	$585,428.12
Demarest	$240,445.81
Dumont	$1,276,439.61
East Rutherford S.A.	$723,313.05
East Rutherford	$841,790.24
Emerson	$494,956.72
Englewood	$2,714,670.60
Englewood Cliffs	$773,818.90
Fairview	$926,971.99
Fort Lee	$3,439,650.47
Hackensack	$4,260,480.88
Harrington Park	$256,287.58
Hasbrouk Heights	$965,080.72
Haworth	$230,995.02
Hillsdale	$680,492.91
Leonia	$644,986.68
Little Ferry	$821,921.44
Maywood	$1,346,493.50
Montvale	$721,298.51
Moonachie	$880,237.94
New Milford	$1,063,936.74
Northvale	$497,828.34
Norwood	$444,470.10
Old Tappan	$19,997.76
Oradell	$640,338.18
Palisade Park	$1,185,674.57
Paramus	$2,332,007.99
Park Ridge	$547,346.51
Ridgefield	$1,288,017.19
Ridgefield Park	$806,447.41

Table 6.1 (Continued)

1995 Service Fees

Subscriber	1995
River Edge	$716,505.37
River Vale	$612,676.76
Rochelle Park	$499,604.63
Rutherford	$767,299.33
South Hackensack	$575,346.07
Teaneck	$3,318,055.63
Tenafly	$992,754.08
Teterboro	$280,233.01
Washington Twsp.	$584,615.50
Westwood	$867,707.63
Wood-Ridge	$484,353.28
Woodcliff Lake	$398,696.41
Con-Rail	$939.05
Del Val Realty	$1,878.09
Edward Williams College	$5,611.67
Edax Realty	$651.05
Glass Gardens	$504.10
H.M.D.C.	$644.81
Leachate	$85,658.81
Lowe Paper	$628,322.14
Macy's Northeast	$232.51
N.T. Hegeman	$17,358.52
NJ Turnpike	$10,962.65
PSE&G	$1,156.73
PSE$G Generating	$5,634.08
Pfister	$438,804.25
Port Authority - Johnson	$4,402.12
Riverside Square	$43,505.19
Trans World Music	$180.94
Transport of NJ	$5,025.36
United Water N.J.	$746,342.65
Total	$48,287,645.94

The BCUA's user charges are based on the quantity and the quality of the wastewater discharged by each municipality, or other users. The three parameters utilized to calculate the user charges are flow, BOD and suspended solids. These parameters were specified by the regulations codified at 40 CFR Part 35, which require that recipients of federal grants collect user charges equitably. The BCUA must adhere to these requirements since the Water Pollution Control Division received grants for the construction of sewerage facilities during the 1970s and 1980s.

Prior to the adoption of the 40 CFR Part 35 regulations, the BCUA collected its charges based solely on flow. The regulations required that BOD and suspended solids also be used to determine the charges. While the regulations required that operation and maintenance charges be collected using BOD and suspended solids as part of the assessment, debt service charges could continue to be collected on the basis of flow. As the BCUA's budget contains both operating and debt service components, it was simple to apply the federal regulations only to the operating budget and continue to collect debt service based on flow.

The BCUA does not collect its charges in the same manner as a potable water supplier or electric utility, which determine their rates for a particular year and then charge the users that rate for the service provided during that year. Rather, the BCUA collects its charges for the current budget based on the flow received during the previous year. As an example, the BCUA's 1995 user chargers are based on 1994 flows. Thus, the municipalities using the BCUA system are aware of their user charges at the beginning of the year and may budget accordingly to cover those charges.

The BCUA determines the flow for each user of the system through the use of flow meters and data recorders located at 166 metering sites. The flow data is continuously recorded on circular charts. Data may be stored on each chart for one week before the chart must be changed. Each chart is reviewed for accuracy by comparing the flow pattern to previous charts and to the total flow historically received at that location. If any discrepancies are perceived, adjustments are made to the total flows or meter maintenance personnel are notified to check the meters for accuracy. In addition, all meters are calibrated once every three months. During the year municipalities are provided with flow reports which indicate the variability of their flow in comparison to the previous year.

The BOD and suspended solids cannot be continuously measured as there are currently no analytical instruments that can perform this function accurately. Therefore, the BOD and suspended solids concentrations at each metering location must be determined through a sampling program. Each metering site is sampled throughout the year according to a schedule which insures that a sufficient number of samples are taken at each location to calculate the user charges fairly and accurately. The number of samples obtained at each site varies according to the amount of flow through the meter, (the more flow, the more samples), and the variability of the flow, (the greater the range of BOD and suspended solids, the more samples). In addition, municipalities with large industrial contributions are sampled on weekends to quantify changes in production that may affect the BOD and suspended solids loadings at these locations.

Over three thousand samples for BOD and suspended solids are taken each year for the user charge system. Due to sampling anomalies, not all data are used. If the results obtained for a site are unusually higher or lower than normal, as determined by statistical calculations, they are not used in the determination of the charges.

Once the budget has been established and all flow, BOD and suspended solids data have been collected and analyzed, the user charges for each subscriber are determined according to the following calculations:

FLOW CHARGES -

$$\$ = \frac{50\% \times \text{Operating Budget} \times \text{Subscriber Flow}}{\text{Total Flow}}$$

BOD CHARGES -

$$\$ = \frac{25\% \times \text{Operating Budget} \times \text{Subscriber BOD}}{\text{Total BOD}}$$

SS CHARGES -

$$\$ = \frac{25\% \times \text{Operating Budget} \times \text{Subscriber Suspended Solids}}{\text{Total Suspended Solids}}$$

DEBT SERVICE CHARGES -

$$\$ = \frac{\text{Debt Service} \times \text{Subscriber Flow}}{\text{Total Flow}}$$

The sum of the above is the total charge to the subscriber.

The BCUA has estimated that 50% of the operating budget is attributable to flow, 25% to BOD and 25% to suspended solids. Thus these factors appear in the user charge calculations presented above.

The BCUA is required by law to establish rates for the unit cost of providing wastewater treatment. The rates are established for treating flow, BOD and suspended solids according to the following calculations:

Flow Rate -

$$\frac{\$}{MG} = \frac{50\% \text{ X Operating Budget}}{\text{Total Flow}}$$

BOD -

$$\frac{\$}{klbs} = \frac{25\% \text{ X Operating Budget}}{\text{Total BOD}}$$

SS -

$$\frac{\$}{klbs} = \frac{25\% \text{ X Operating Budget}}{\text{Total Suspended Solids}}$$

Debt Service -

$$\frac{\$}{MG} = \frac{\text{Debt Service}}{\text{Total Flow}}$$

Where MG = Million Gallons and Klbs = 1000 lbs.

It is evident that the operating and debt service charges are effected by the total flow received and thus in wet years the rates will drop and in dry years the rates will rise. A falling rate may not translate into a lesser charge for a subscriber as a subscriber's flow may increase in relation to the flows discharged by other subscribers.

A better indication of the degree to which a subscriber's charges are changing is a ratio referred to as the percent distribution, calculated as follows:

$$PD = \frac{\text{Subscriber Flow}}{\text{Total Flow}}$$

$$PD = \frac{\text{Subscriber BOD}}{\text{Total BOD}}$$

$$PD = \frac{\text{Subscriber SS}}{\text{Total SS}}$$

Where PD is the percent distribution of each parameter.

The percent distribution more accurately reflects how a subscriber's charges will vary with changing quantities of flow, BOD and suspended solids. As this percent distribution goes up, so do the charges and vice versa.

6.3 Tier II

The purpose of the Tier II System is to notify each individual user of the system of the portion of their municipal taxes that is allocated to the BCUA charges when municipal taxes are used as the basis of collecting BCUA charges. The information is calculated by the BCUA and is printed on the tax bills sent to the taxpayers by the municipality.

In addition the Tier II System also determines if Significant Industrial Users (SIU's) and tax exempt properties within a municipality that collects its sewer user charges from municipal taxes are paying their fair share of the sewer user charges. The BCUA determines how much each industry and tax exempt user contributes to local municipalities sewer user charges and provides this information to the municipality. If the sewer user charge for an industry exceeds its taxes then the municipality must collect this additional amount from the industry. Tax exempt properties may be charged by the municipality for their sewer user charges. The BCUA collects no additional revenue from the Tier II System.

BERGEN COUNTY UTILITIES AUTHORITY

SEWER SYSTEM EVALUATION REPORT

FOR THE

RUTHERFORD-EAST RUTHERFORD-CARLSTADT

JOINT-MEETING

March 1984

CONSULTING ENGINEERS

Clinton Bogart Associates

Clinton Bogert Associates

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William Wheeler

March 15, 1984

Bergen County Utilities Authority
Post Office Box 122
Little Ferry, New Jersey 07643

Re: RERC Joint Meeting
Sewer System Evaluation Report

Gentlemen:

In accordance with the terms of our Contract and in compliance with the Rules and Regulations of the USEPA and NJDEP, we are herewith transmitting the Sewer System Evaluation Report for the Rutherford-East Rutherford-Carlstadt Joint Meeting (RERC-JM). This Report includes the results of the authorized Inflow Investions and Flow Isolation meterings along with pertinent material which updates the 1977 RERC-JM Facility Plan. Specific sewer reaches with excessive infiltration rates are identified, as are specific sources of inflow which may be eliminated cost effectively. A program to reduce the I/I, primarily by testing and sealing sewer joints, is recommended. The cost-effectiveness of municipal or RERC-JM implementation of the recommended program is also analyzed.

We thank you for the opportunity to participate in this project and are ready to continue to assist in implementing the RERC-JM Extension Project.

Very truly yours,

CLINTON BOGERT ASSOCIATES

Ivan L. Bogert

Ivan L. Bogert, P.E.
NJ License No. 6341

ILB/DHH:pm
Enclosure

cc: Bergen County Utilities Authority (4)
Stephen P. Sinisi, Esq.
Mr. Thomas Varro, NJDEP, w/2 encl.
USEPA, w/encl.

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BERGEN COUNTY UTILITIES AUTHORITY

SEWER SYSTEM EVALUATION REPORT

FOR THE

RUTHERFORD-EAST RUTHERFORD-CARLSTADT

JOINT-MEETING

March 1984

CONSULTING ENGINEERS

Clinton Bogert Associates

LIST OF TABLES

(Included in Text)

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BCUA SEWER SYSTEM EVALUATION
FOR THE RERC JOINT MEETING

SECTION I
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Background

The RERC-JM. The Rutherford-East Rutherford-Carlstadt Joint Meeting (RERC-JM) was formed as an intermunicipal sewer district in 1938. In 1939 and 1940, the RERC-JM constructed a secondary treatment plant in Rutherford, which discharges effluent to Berry's Creek. The RERC-JM also constructed interceptors, including a main trunk sewer along NJ Route 17 in East Rutherford, to convey flow from Carlstadt and East Rutherford to the Plant. These RERC-JM facilities serve the portions of its three member municipalities which are within the Hackensack River drainage basin and which generally lie west of the Hackensack Meadowlands, although the tributary portions of Carlstadt and Rutherford extend eastward to Berry's Creek. Plate 1 indicates the current Service Area.

The BCUA. In 1947, the Bergen County Sewer Authority [reformed in 1978 as the Bergen County Utilities Authority (BCUA)] was created by an act of the State Legislature to abate water pollution in the Hackensack River and its tributaries. The BCUA's designated Sewer District includes the 50 Bergen County municipalities which are wholly or partially within the Hackensack River drainage area, including the RERC-JM Service Area. The BCUA constructed and operates a large regional sewage treatment plant in Little Ferry. The BCUA also constructed trunk and interceptor sewers which allowed the abandoning of existing inadequate municipal treatment plants and provided an outlet for municipalities constructing new sewer systems. The BCUA currently provides sewer service to 43 municipalities, including the eastern portions of Carlstadt and East Rutherford.

Proposed Flow Transfer. By the mid-1960s, it became evident that the RERC-JM Treatment Plant was unable to meet Federal and State Waterway Standards. Facilities Plans in 1966, 1971, 1973 and 1977 indicated the cost-effectiveness of transferring all RERC-JM flow to the BCUA regional system. The Facilities Plans recommended that the BCUA construct the RERC-JM Extension, which includes a pumping station at the RERC-JM Plant, along with a two-mile force main sewer discharging to an existing BCUA force main in Carlstadt. From the Carlstadt connection, RERC-JM flow would continue three miles eastward through the BCUA East Rutherford Extension Force Main and Southwest Trunk Sewer for treatment at the BCUA Plant in Little Ferry.

Federal Funding Requirements. One purpose of the 1977 Facility Plan was to qualify the BCUA's RERC-JM Extension Project for Federal funding. Based on the current NJDEP Priority List, partial Federal funding may be forthcoming in Fiscal Year 1986, if Congress extends the current Clean Water Act in 1985. The Clean Water Act of 1972 (P.L. 92-500) required that Facilities Plans submitted after June 1973 include an Infiltration/Inflow (I/I) Analysis.

I/I Analysis. I/I includes all ground and surface waters entering the sanitary sewer system. This extraneous flow generally constitutes a substantial portion of the total sewage flow and the major portion of the peak sewage flow. I/I is defined as excessive if the overall cost of eliminating a portion of the extraneous flow is less than the cost of transporting and treating that portion. If the I/I Analysis indicates the presence of excessive I/I, USEPA regulations require a subsequent Sewer System Evaluation (SSE) to develop specific plans for reducing the I/I.

The I/I Analysis in the 1977 BCUA RERC-JM Facilities Plan, as amended in 1979, indicated the presence of excessive I/I in the municipal sewer systems tributary to the RERC-JM Plant.

Based on an analysis of 1972-76 continuous flow records from the RERC-JM Plant meter, it was determined that the normalized average I/I admitted by the tributary sewers was about 25 to 30 percent of the total RERC-JM Plant flow and about 65 to 75 percent of the peak flow.

The I/I rates in the sewers tributary to the RERC-JM Plant are constantly varying in response to groundwater conditions and precipitation. The I/I rate ranges from zero in very dry periods to a sustained peak of about 12 mgd during severe wet weather, high groundwater periods. Table 1 indicates the currently estimated peak and average I/I flows.

The major source of the high I/I appeared to be intermittently leaky non-watertight sewer joints. Most of the 46 miles of municipal sewers tributary to the RERC-JM Plant were constructed from clay pipe prior to 1930. A typical mile of old clay municipal sewer, including connected service laterals, has about 3000 joints. During average conditions, the groundwater, which is the source of the infiltration, submerges only a small percentage of the sewer pipe joints. During very wet high groundwater periods, the number of submerged joints may increase tenfold.

To determine the distribution of this high infiltration, the tributary system was subdivided into 22 minisystems, each averaging about two miles in length. The outlet flows of each minisystem were metered on nights during the winter of 1976, a time period when infiltration was higher than average. Revised Table 8 of the Facility Plan indicated the normalized infiltration determined for each minisystem. Table 2 in this Report indicates the current slightly revised estimate of the normalized infiltration per minisystem based on the results of the flow isolation monitoring.

Based on a preliminary analysis, it was indicated that it may be cost-effective to reduce the I/I by about 30 percent, by disconnecting sources of inflow and repairing leaky sewer joints. Accordingly, the I/I Analysis recommended that the BCUA, aided by a 75-percent Federal grant, implement the required Sewer System Evaluation.

Scope of Report

Sewer System Evaluation. The following two SSE phases were recommended in the I/I Analysis:

1. A flow isolation and metering phase to determine the infiltration rates of specific sewer reaches in minisystems with high infiltration rates as determined during the I/I Analysis. Sewer reaches with high infiltration rates were to be recommended for inclusion in a contract to reduce the infiltration by testing and sealing sewer joints.

2. An inflow investigation phase which included smoke testing the entire sanitary system to detect illicit sources of inflow such as catch basins. Manhole inspections, dyed water tests to confirm inflow sources and the development of a program to eliminate the sources fo I/I detected, were also part of this phase.

By 1982, the NJDEP had approved the scope of work and awarded the Grant to fund the SSE. In 1982, the NJDEP authorized the commencement of the Evaluation. This Report includes the results of that Sewer System Evaluation. This Report also includes an updating of certain 1977 Facility Plan data as authorized by the NJDEP.

Summary and Conclusions

Flow Isolation. The flow isolation and metering program, conducted in 11 of the 22 minisystems, detected about 10 miles of sewer in which a program of testing and sealing the sewer joints to reduce infiltration would be cost-effective overall (based on USEPA criteria). Smoke testing and subsequent dyed water flooding detected another half-mile of sewer which may admit indirect inflow. These sewers would be overall cost-effective to include in the test and seal program. The SSE results indicating specific sewers which are overall cost-effective to test-and-seal are in Tables 3a-A through 3a-U and 3b. The 1984 cost of the test-and-seal program may be about $360,000. The program may reduce the average I/I by about 245,000 gpd and the peak I/I by about 2.5 mgd.

Inflow Investigation. The smoke testing phase detected catch basins connected to the sanitary system (Table 4a) and cross-connections between the storm and sanitary system (Table 4b). The manhole inspections associated with the SSE disclosed leaky manholes (Table 4c) and manhole covers subject to tidal flooding (Table 4d). The 1984 rehabilitation cost of eliminating I/I from these sources is about $90,000. Rehabilitation may reduce the average flow by about 8000 gpd, and the peak flow by about 680,000 gpd.

The smoke testing also detected sources of inflow on private property, including roof and surface drains connected to the sanitary system (Tables 5a and 5b). Disconnection of these sources may cost about $5000 and reduce average I/I by about 4000 gpd and the peak flow by about 530,000 gpd. Miscellaneous sewer defects located during the SSE, which may not allow excessive I/I but may warrant repair, are listed in Table 6.

Cost-Effective I/I Reduction. This Report evaluates the cost-effectiveness of I/I reduction by two separate criteria--the overall cost-effectivness criteria as established by USEPA and the cost savings resulting from reduced BCUA user charges to the RERC-JM municipalities.

Overall Cost-Effectiveness. This Report was funded by the USEPA to determine the I/I reductions which are overall cost-effective based on USEPA criteria. Additionally, if grant funds were to become available, only those repairs on public property which were overall cost-effective would be eligible for funding. Furthermore, the USEPA requires the elimination of all excessive I/I tributary to federally funded projects. Overall cost-effectiveness based on USEPA criteria equates the cost of eliminating the I/I with the incremental cost of constructing additional facilities to transport and treat the peak I/I, plus the incremental present worth of 20 years of annual operating and maintenance cost of all facilities handling the I/I. Overall cost-effectiveness is dependent on broad assumptions regarding "estimated," I/I reductions "acceptable" diversions and design criteria, "projected" future flows and the "schedule" of future system modifications. Since the estimates, standards, projections and schedules are continuously under revision, no overall cost-effectiveness analysis is every firmly fixed. Because of the considerable uncertainties, the overall cost- effectivness in this analysis has been based on generalized typical costs of rehabilitation versus typical transport and treatment facilities costs, rather than a site-specific analysis for each source noted.

In 1981, the BCUA issued an SSE Report covering the present BCUA Service Area. For the sake of compatibility, 1981 costs were also used in the overall cost-effectivness analysis in this analysis. The basis of the 1981 present worth overall cost savings benefit of $0.64 for each gpd that the peak flow is reduced, plus $0.60 for each gpd that the average flow is reduced, is summarized in Section VIII of this Report.

Based on the I/I sources and sewers with high infiltration rates detected during the SSE, it may be possible to cost-effectively reduce the peak I/I by about 3.6 mgd and the average I/I by about 0.24 mgd. The 1981 cost of this rehabilitation was estimated to be about $550,000, and the overall cost savings resulting was estimated to be about $2,500,000. Table 1a summarizes the cost-effective reductions by I/I source category.

Local Cost Savings. The proposed I/I reductions will also result in lower BCUA user charges for the RERC-JM and the three municipalities. The charge may be reduced about $0.20 per year per gpd that the average I/I is reduced. For the local cost analysis, the project costs have been revised based on recent actual test-and-seal bid prices and inflation since 1981. Based on the re-estimated 1984 project cost of $453,000, the municipalities or the RERC Joint Meeting may recover the cost of the rehabilitation in 11 or 12 years from reduced BCUA charges. Table 1b indicates revised cost of each phase of the I/I reduction program, the initial annual reduction in BCUA user charge which may result from its implementation and the time span required for the phase to pay for itself, based on an interest rate of 8 percent, a BCUA user charge inflation rate of 4 percent and a debt service equal to the annual BCUA charge reduction. The local cost savings resulting from reduced sewage flooding and sewer surcharging during very wet weather are not included in Table 1b. Nor are the savings resulting from reduced sewer collapses and an increased hydraulic structural life span for the sewers, which may result from implementation. If these costs were considered, the time indicated for the project to pay for itself would be decreased.

Grant Availability. Current USEPA grant availability is determined by a project priority list established by the NJDEP. Based on current Federal funds available to the State and the present ranking of the project of sewer rehabilitation in the RERC-JM, funds may be available by the mid-1990s. However, the Grant Eligible portion of the project would be small. Based on the presently proposed regulations, only 55 percent of the eligible construction cost, which is about 35 percent of the project cost, may be Grant reimbursable. It does not appear cost-effective for the municipalities or RERC-JM to delay implementation about ten years to obtain about $140,000 in grant funds, thereby foregoing the potential BCUA user charge reduction of $50,000 per year during that period resulting from implementation of the I/I reductions without delay.

Recommendations

Rehabilitation. In the absence of 75 percent project funding, and because any metered flow reduction will increase BCUA unit user charges for the foreseeable future, the BCUA does not plan to implement any repairs in the tributary municipal systems. It is recommended that either the RERC-JM or its member municipalities implement the I/I reduction program, summarized in Tables 3 and 4, and that the property owners disconnect the sources of inflow on private property, summarized in Table 5.

The major phase of the overall cost-effective program, the test-and-seal program summarized in Table 3 and noted on Plate 3, appears cost-effective for the RERC-JM or its member municipalities to implement based solely on reduced BCUA charges. However, the cumulative reduced BCUA charges resulting from recommended inflow reductions often do not cover the cost of diverting the inflow sources detected for many years. The high peaks from these sources contravene the BCUA regulation which prohibits sources which may cause the overloading of its system. It is recommended that BCUA request the disconnection of the inflow sources noted in Tables 4 and 5.

For reasons previously cited, it is recommended that the RERC-JM or the municipalities implement the recommended program at this time without Federal grant. However, if major sources of I/I are detected during the test-and-seal program, which cannot be repaired without large, additional expenditures, it is recommended that consideration be given to seeking Grant assistance for those repairs.

Continuing Evaluation. The rehabilitation recommended in this Report should be considered as an initial step in reducing the excessive flows and repairing the municipal sewers. Unless evaluation and subsequent rehabilitation are repeated periodically as part of each municipality's operation and maintenance programs, the systems will continue to deteriorate and the I/I will slowly increase. Specific evaluation techniques which the municipalities may adopt are indicated in Section X of this Report.

Impact on Facility Sizing

As indicated in Section V of this Report, the proposed RERC-JM Extension Pumping Station and Force Main have been designed for a peak flow of 13.8 mgd and an average flow of about 3.4 mgd. The Facility was also designed with the capability of conveying peak initial flows of about 17.5 mgd using polymers at times of peak flows. Polymer injection equipment may be temporarily installed to increase the hydraulic capacity of the force main during the maximum wet weather peaks prior to the successful implementation of the recommended I/I reduction program.

Based on a slightly revised estimate of the distribution of components in the present flow, the potential I/I reductions which the recommended rehabilitation may achieve and the projected small increase in the base sanitary sewage as indicated in Table 1, the design flows still appear valid. Thus the present hydraulic design of the proposed pumping station and force main does not require any modification provided that the Service Area is not increased to include the Lyndhurst-North Arlington Joint Meeting.

SECTION II
SERVICE AREA

Alternative Areas. As of February 1984, the extent of the area to be served by the RERC-JM Extension Project remained unresolved. BCUA has been engaged in negotiations to provide sewage treatment for the North Arlington-Lyndhurst Joint Meeting (NAL-JM). The NAL-JM intermunicipal sewer district which lies directly south of the RERC-JM, is under Orders to either upgrade its present sewage treatment plant or divert its flow to the BCUA or the PVSC regional systems. If the NAL-JM flow is diverted to the BCUA system, the most cost-effective route would be via the proposed RERC-JM Extension facilities.

If the RERC-JM Service Area is enlarged to include the NAL-JM, the hydraulic capacity of the proposed RERC-JM facility would need to be doubled. This would provide capacity for not only the present NAL-JM Service Area but the undeveloped Hackensack Meadowlands to the east; including capacity to serve the proposed Berry's Creek Center, the proposed BCUA Resource Recovery Facility and leachate from the BCUA landfills. Plate 1 indicates this extended RERC-JM Service Area and the route of a possible BCUA gravity interceptor to serve the NAL-JM.

The flows and Service Area presented in this Report are based on the RERC-JM Extension not serving the NAL-JM. The effect of the possible Service Area expansion may be addressed by a supplemental report, should the decision be made to include the NAL-JM.

Location. The present 3.0-square mile RERC-JM Service Area includes the following portions of the following boroughs:

TABLE II-1

RERC-JM SERVICE AREA

Boroughs	Area sq mi	Boundaries East	Boundaries West
Carlstadt	1.1	Berry's Creek	Wallington boundary
East Rutherford	0.7	Pascack Valley-Hoboken Railroad	Passaic Valley drainage divide
Rutherford	1.2	Berry's Creek	Passaic Valley drainage divide

The rectangular Service Area is also bounded by Wood-Ridge on the north and by Lyndhurst on the south. Plate 1 identifies the area currently served by the RERC-JM. Municipal sewers and a RERC-JM trunk sewer along NJ Route 17 convey sanitary sewage from the Service Area to the RERC-JM Plant in Rutherford located about 1000 feet east of Route 17 along the East Rutherford boundary.

Early Development. The present boundaries of the RERC-JM municipalities developed from the subdivision of Bergen County into successively smaller townships and boroughs. From 1693 to 1826, the Service Area was part of New Barbadoes Township, which included most of present Bergen County west of the Hackensack River. In 1826, the Area became part of Lodi Township. The East Rutherford and Rutherford portions were transferred into Harrison Township, Hudson County in 1840 but were returned to Bergen County in Union Township in 1852. Carlstadt was incorporated as a village in Lodi Township in 1860 and as a 4.1-square mile borough in 1894. East Rutherford was incorporated as the Township of Boiling Springs in 1889 and as the 3.9-square mile Borough of East Rutherford in 1894. The Borough of Rutherford was incorporated in 1881. After a boundary adjustment in 1890, Rutherford attained its present area of 2.8 square miles.

During the colonial and post-colonial periods, roadways were constructed through the RERC-JM Area which are now an integral part of the County's secondary road system. These roadways expedited the movement of troops and equipment during the Revolutionary War. Main railroad tracks were constructed across the Service Area in 1833 and in 1859. By the Civil War, the roads were lined with residences and the railroads were part of a rapid transit network which was soon to become national in extent. The Carlstadt portion of the Area had become the commercial center of southern Bergen County. Several blocks adjacent to Hackensack Avenue were developed with hotels, stores and taverns. In the post-Civil War period many factories were constructed near the railroads in East Rutherford and Carlstadt and major residential development occurred in all three boroughs. By 1900, Rutherford was the third most populous borough in the County with a largely well-educated, white-collar work force.

Residential Development (Population). Although the RERC-JM Service Area includes about 28 percent of the total area of the three boroughs, it houses about 64 percent of the boroughs' residential populations. The current official population of the RERC-JM Service Area is 21,035, based on a block-by-block compilation of the 1980 U.S. Census. The distribution of this population by municipality and in terms of total municipal population is indicated in Table II-2.

TABLE II-2

PRESENT POPULATION

Municipality	1980 RERC-JM Population	Percent of Municipal Population
Carlstadt	6,128	99.4
East Rutherford	4,945	63.0
Rutherford	9,962	52.2
RERC-JM	21,035	63.6

The initial impulse of residential development in the RERC-JM Service Area occurred in the latter part of the Nineteenth Century. By 1900, the Service Area housed about 6,900 residents, or about 33 percent of the current population. Residential growth continued rapidly during the early part of the Twentieth Century. By 1930, the Service Area population reached about 17,600, or about 84 percent of the current population. During the past 54 years, residential growth has been slow. This has been due to the diminishing supply of vacant, residentially-zoned land and the steady decrease in persons per dwelling unit. By 1980, there was an average of only 2.60 residents per dwelling unit.

Currently, there is virtually no vacant residentially-zoned land in the Area and the number of persons per dwelling unit is still decreasing. On this basis, little increase in residential population in the RERC-JM Service Area is projected for the foreseeable future. The Bergen County Planning Board forecast an additional 950 residents in the year 2000 which would increase the Service Area total to 21,985 residents.

<u>Non-Residential Development</u>. The RERC-JM Service Area includes roughly as much land zoned for industrial, commercial and office use as is zoned for residential use. The major areas zoned for business include all the land adjacent to and east of NJ Route 17, the land along the railroad north of the Rutherford boundary in East Rutherford and the land along the railroad east of the Wallington boundary in Carlstadt. Additionally, local commercial centers are located along Hackensack and Paterson Avenues in Carlstadt and East Rutherford and along Park Avenue in Rutherford. The main campus of Fairleigh Dickinson University is located along the western boundary of the Service Area in Rutherford.

Although some of the Service Area industries have been in existence for about 100 years, there has been substantial increase in the industrial and commercial land developed during the past 15 years. The impetus for this development has been the Meadowlands industrial development, the New Jersey Sports Complex directly east of the Service Area and the highway improvements completed to serve the Complex. The Hackensack Meadowlands Development Commission (HMDC) regulates the industrial development along the eastern boundary within the RERC-JM Service Area. About 15 percent of the land zoned for business remains vacant. Based on the rapid recent development, it is reasonable to expect that most of the vacant land will be developed by the year 2000.

Transportation and Utilities. The colonial road system and the railroads crossing the Service Area provided the network for inter-regional transportation in the Nineteenth Century. State Highways including Routes 3, 17 and 20 within the Service Area, the New Jersey Turnpike and Route 21 within one mile of the Service Area; and the Lincoln Tunnel and George Washington Bridge, which cross the Hudson River five miles east of the Service Area, convey most of the inter-regional transportation today. Within the Service Area, a fully-developed system of local roads, laid out in a grid pattern in Carlstadt and East Rutherford and in a combined radial and grid pattern in Rutherford, handles the local traffic. Teterboro Airport, one mile northeast of the Service Area and Newark International Airport, seven miles to the south, provide air transport to the RERC-JM.

Potable water, supplied by the Hackensack Water Company and gas and electricity supplied by the PSE&G Company, are available to all buildings in the RERC-JM Service Area. The municipally-owned sanitary sewer systems, described in Section III of this Report, serve virtually every building in the Service Area. Each borough also maintains its own storm drainage system within the Service Area.

Topography. The RERC-JM Service Area includes a diverse range of topographic features. To the east of Route 17, the terrain is flat with most elevations less than ten feet above sea level. West of Route 17, the land rises rapidly.

Elevations along the ridge top one-half mile west of Route 17 range from 200 feet in Carlstadt to 130 feet in Rutherford. The ridge top descends to elevation 50 along the Rutherford-East Rutherford boundary, forming a gap through which drainage from the area west of the ridge top flows eastward to Berry's Creek. Thus, all of the Service Area is drained to Berry's Creek with the exception of about 50 acres in the northwestern corner, which is drained to the Passaic River.

Soils and Subsurface Conditions. The soil in the portion of the RERC-JM which is east of Route 17, consists of fill overlaying tidal marsh of marine origin, which includes a layer of organic material over a highly compressible layer of silty clay. Subsurface drainage in this area is poor and the groundwater is high. The soil in the residentially developed portion of the Service Area west of Route 17 is a ground glacial moraine. This moraine has good subsurface drainage in Carlstadt and intermediate to good drainage in East Rutherford and Rutherford. Groundwater is generally below the sewers except after long periods of precipitation. The depth to bedrock generally exceeds ten feet except at the ridge top in Carlstadt where the sandstone bedrock is within six feet of the surface.

Climate. The average annual temperature in the area is 54°F with monthly averages varying between 75°F and 32°F. Extreme temperatures vary 40° from the monthly average during the winter and 30° from the monthly average during the summer. Extreme temperature variationss are infrequent. Generally, temperature is moderated by the proximity of the Hackensack River wetlands and the

Atlantic Ocean. The nearness of these waterways often produce relatively high humidity.

The long-term annual precipitation recorded at the Central Park, New York Gage, five miles east of the Service Area, is 44 inches. Precipitation is fairly well distributed throughout the year with slightly more than average rainfall occurring during the summer months. Extreme monthly rainfalls have varied from practically no rain to four times the long-term monthly averages. Warm weather rainfalls tend to be shorter, more widely spaced and more intense than cool weather rainfall. Snow constitutes about five percent of the total precipitation and is a relatively minor factor in the hydrologic cycle. The interrelation of precipitation, inflow and infiltration, is more fully discussed in Section V of this Report.

Hydrological Cycle. Although rainfall is well distributed throughout the year, stream flows and groundwater levels are generally highest in the early spring, and lowest in early autumn. This seasonal variation is caused by higher evaporation and plant life usage during the warmer months. The plant life in the region is predominantly deciduous, and so, is strongly affected by seasons. From November through March, the sun is close to the horizon and is often blocked by clouds. The grass and most trees lie dormant due to the decrease in sunlight and the cold temperatures. During this period, evaporation and plant life consume minimal groundwater. Accordingly, during the cool months, most of the precipitation on previous surfaces either soaks into the soil, recharging the groundwater, or runs off as storm drainage. In April and May, the plants rejuvenate, requiring more water. Between June and October, the substantial groundwater needs of the plant life and evaporation from the high, hot sun deplete the available groundwater. During the warm months, more than half the precipitation on pervious surfaces either evaporates or is utilized by the plant life.

SECTION III

EXISTING SANITARY SEWER SYSTEM

Development. Most of the sanitary sewers in the Joint Meeting Service Area were constructed between 1900 and 1920 by the Boroughs of Carlstadt, East Rutherford and Rutherford. Between 1900 and 1940, the outlets for the three municipal sanitary sewer systems were rudimentary municipal sewage treatment units which discharged effluent to Berry's Creek. The treatment provided by these primary facilities was inadequate to meet the effluent standards of the 1930's which were less stringent than current standards. The waterway quality deterioration caused by the effluents was compounded because Berry's Creek is a tidal estuary, and the upstream flow is not sufficient to convey the effluent to the mouth of Berry's Creek during a single tidal cycle.

In 1936, the State Department of Health adopted a resolution requiring secondary treatment for all sewage discharged to the Hackensack River and its tributaries, including Berry's Creek. To comply with this directive, the three boroughs determined that a single secondary treatment plant, to treat sewage from the portions of the municipalities in the Berry's Creek drainage area, would be cost-effective. (Sewage from the portions of East Rutherford and Rutherford in the Passaic River drainage area has been tributary to the PVSC Regional System since about 1910.) Accordingly, in 1938, the Rutherford-East Rutherford-Carlstadt Joint Meeting (RERC-JM) was formed by the three boroughs. The RERC-JM was empowered to construct, operate, maintain and finance a secondary sewage treatment plant and the trunk sewers needed to convey sewage from the municipal systems to the Plant. The RERC-JM Treatment Plant in Rutherford and the trunk sewers were constructed as WPA Projects in 1939 and 1940 (N.J. 1400F, Contracts 1 and 2).

During the last 45 years, each of the three boroughs has extended its municipal system to serve the industrial development which has occurred east of NJ Route 17.. Carlstadt also extended its system to serve the industries along its western boundary. Municipal Sewer Authorities in the Boroughs of East Rutherford and Carlstadt have also constructed sewer systems to serve industries and the NJ Sport Complex in the meadowlands, east of the RERC-JM Service Area. In the late 1960's, the BCUA constructed trunk and interceptor sewers which provide service to these Meadowlands areas.

By the 1960's, it was evident that the effluent from RERC-JM Plant was not meeting the State and Federal effluent standards. A number of the treatment units at the plant had suffered severe deterioration and had been permanently removed from service. Since 1966, the RERC-JM has been engaged in negotiations with the BCUA to transfer the RERC-JM flow to the BCUA system. The BCUA's Southwest Trunk Sewer and East Rutherford Extension Force Main were constructed with sufficient capacity to convey the RERC-JM flow. The flow is proposed to be transferred by a pumping station constructed by BCUA at the site of RERC-JM Plant, and a 1.9-mile force main connecting the station with the existing BCUA East Rutherford Extension. The BCUA sewers, through which the RERC-JM flow would be routed, are indicated on Plate 1.

Description. There are about 48 miles of gravity sewers, excluding building connections, which are tributary to the RERC-JM Plant. About 45.9 miles of 8- to 24-inch diameter sewers were constructed by the municipalities. Parallel East Rutherford and Rutherford trunk sewers convey sewage from the western portion of the Service Area eastward through the gap in the ridge along their common boundary. Flow from western Carlstadt is conveyed in the East Rutherford municipal trunk sewers. The municipal systems discharge to sewers which were constructed by the RERC-JM. This includes 1.4 miles of 24- and 36-inch diameter trunk sewer in Route 17 conveying flow from Carlstadt and East Rutherford to the RERC-JM Plant and 0.7 mile of smaller diameter sewer conveying Carlstadt and Rutherford flow through meter chambers. The length of sewer tributary to the RERC-JM in each municipality is listed in Table 2. The general layout of the trunk sewer system is indicated on Plate 1. Plate 2 includes a more detailed sewer system map.

About 40 miles of 4-inch and 6-inch diameter building connection sewers are tributary to the system, providing service to each of the 5000 buildings in the Service Area. Access manholes are located at each junction, change of diameter or slope, and along straight reaches longer than 350 feet. The average spacing of manholes in the RERC-JM tributary system is 240 feet. Since most of the Service Area is within the Berry's Creek drainage area, most of the sewage flows to the plant without pumping. The only pumping station in the system serves Industrial Road in western Carlstadt, which is in the Passaic River drainage area.

The RERC-JM constructed five meter chambers, three to monitor Carlstadt flow entering East Rutherford, one to monitor Carlstadt and East Rutherford joint flow upstream of the treatment plant, and one to monitor Rutherford's flow upstream of the treatment plant. These meters have been out of service for many years. Upon construction of the BCUA RERC-JM Extension, the BCUA plans to refurbish the four meter chambers serving Carlstadt and Rutherford. The meter monitoring East Rutherford and Carlstadt joint flow will be reconstructed nearer the proposed pumping station because of access difficulty at the present location. Plate 1 indicates the location of the proposed meter chambers. The flows monitored at these locations may serve as the basis for the distribution of BCUA user charges to each municipality.

There is presently continuous metering of flow at the RERC-JM Plant, consisting of a Parshall flume, located downstream of the plant pumping station. There are indications that there are long periods when the flows recorded by this meter are not accurate.

During periods of peak wet weather flow, there are indications that the capacity of the Rutherford trunk sewer is inadequate. Cross-connections were built into the walls of Manholes O-140 and O-160. If the sanitary sewer surcharges, the excess sewage may overflow into an adjacent storm system through these cross-connections.

Construction Details. The municipal collector and trunk sewers were constructed at an average depth of 7 feet below the ground surface. Depths range from 3 to 15 feet, depending on topography, hydraulic requirements and interference with other utilities. The depth of the main RERC-JM trunk sewer ranges from 8 to 20 feet. Generally, sanitary sewers are the deepest utility in the streets. Building connection depths average 2 to 3 feet less than collector sewer depths. The 3- to 5-foot wide trenches in which the sewers were constructed were usually filled with a porous granular material. Practically all the municipal sewers installed prior to 1930 were constructed of 3-foot lengths of vitrified clay pipe (VCP) jointed with cement and oakum. The joints of municipal sewer installed within the last 35 years were sealed with rubber rings. Some of the more recent sewer pipes have been constructed of asbestos-cement, cast iron or concrete with up to 13 feet spacing between joints. The larger diameter sewers, installed by the RERC-JM, were constructed of reinforced concrete pipe with joints packed with oakum and sealed with a hot-poured bituminous compound. Building connection sewers were generally installed by plumbers or housing contractors using short lengths of clay pipe or cast iron pipe with leaded joints. Manhole barrels were constructed of brick and topped with cast iron rims and covers. Most of the manhole covers are perforated with both pick and vent holes. When the original municipal systems were constructed, it was an accepted practice to include lampholes and flush shaft connections to the sewers. In recent years, the flush shafts were disconnected and the lampholes were paved over during roadway resurfacing.

Operation and Maintenance. The RERC-JM municipalities have independent sewer maintenance programs. In general, all sewers are cleaned with high-pressure hoses with jet nozzles, rodders or bucket machines at regularly scheduled intervals, ranging from several times a year in East Rutherford to once every two years in Rutherford. Basement backups, blockages and other problems are corrected by the local DPW's as they are reported. In Carlstadt, sewers in the vicinity of Manholes B-400, B-408, D-170, D-270 and E-160, located on Plate 2, suffer root intrusion or buildups of paper and detergent. In Rutherford, the sewers in Washington Avenue between Manholes S-100 and S-140 are reported to accumulate solids and need frequent cleaning. These sewers are afforded regular attention by the DPW.

SECTION IV
AVERAGE SEWAGE FLOW

Components. The components of RERC-JM sewage flows by source are illustrated in Table IV-1.

TABLE IV-1
SANITARY SEWAGE SOURCES

- Sanitary Sewage
  - Sanitary Base
    - Residential
    - Non-Residential
      - Employee-Commercial
      - Industrial Waste
  - I/I
    - Infiltration
    - Inflow
      - Direct
      - Indirect

The primary subdivision of sanitary sewage sources is between sanitary base and I/I. By definition, sanitary base originates as wastewater from the buildings served by the sewer system. Sanitary base may be subdivided into its residential and non-residential components. Non-residential base flow generated by employees and commercial enterprises may be differentiated from industrial waste. By definition, the I/I component originates as surface runoff or groundwater and is intentionally or inadvertently conveyed by the sanitary system. Generally, the groundwater leaking into the system is considered infiltration, and surface drainage entering the system is considered direct inflow. Indirect inflow is a hybrid component which includes groundwater entering the system through pipes which are either foundation drains or basement drains. Defective parallel storm sewers may also contribute indirect inflow through leakage into sanitary sewers.

<u>Total Present Flow</u>. The estimate of the present normalized average RERC-JM sewage flow included in the revised I/I Analysis in the Facility Plan was based on 1974 data. Over the past ten years, there have been periods of water rationing and severe economic recessions which have significantly affected the base flow quantities. There have also been system repairs, new leaks developed and new sewers installed which have changed the normalized average I/I. Additionally, over this period, the USEPA has been continually revising its estimates of allowable design flow. Incorporating each change as it occurs would result in the design flows for the facilities never being fixed.

In 1982, the design of the proposed facilities was completed based on design flows in the Facility Plan as modified by studies continuing up to the time of design.

The results of this Sewer System Evaluation could potentially result in minor modifications to the design flow based on updated estimates of the I/I which can be cost-effectively eliminated. However, it is not cost-effective to revise completed facility designs on account of minor revisions of projected flow. Accordingly, the present and projected flow components have been reasonably re-estimated for the purpose of maintaining the total design flows upon which the facilities have been designed. The basis of these re-estimates are discussed in this Section. These currently estimated flows are tabulated in Table 1. The total flows listed in Table IV-2 are essentially the same as the flows used to design the BCUA RERC-JM Extension.

TABLE IV-2
DESIGN FLOW TOTALS

	Average (mgd)	Peak (mgd)
Present		
with no I/I reduction	3.42	16.9
with I/I reduction	3.17	13.2
Projected		
with no I/I reduction	3.65	17.5
with I/I reduction	3.40	13.8

Infiltration. The estimated normalized average infiltration, based on 1979 revisions to the Facility Plan, was 1.00 mgd. However, the flow isolation metering results located only 0.49 mgd in the 11 minisystems in which 0.93 mgd had been expected. To resolve this discrepancy, the total RERC-JM infiltration was reestimated using 1982 data from a period when the RERC-JM Plant meter appeared reasonably accurate. Based on a comparison with BCUA flow variations for ten relatively dry periods, between January and May 1982, the normalized average infiltration was reestimated to be 0.80 mgd.

This infiltration was distributed to the isolated minisystem, based on the total field metered infiltration, listed in Tables 3a, plus an allowance of 400 gpd per inch-mile, to account for the discrepancy between the revised total infiltration and the flow isolated infiltration. Infiltration was allocated to the non-isolated minisystem on the basis of 0.69 x the 1979 estimated infiltration plus an allowance of 400 gpd per inch-mile. Table 2 indicates this revised distribution of present infiltration by minisystem and municipality.

The projected design infiltration (0.56 mgd average; 5.54 mgd peak) was based on the potential infiltration reductions (0.24 mgd average, 2.46 mgd peak) resulting from the recommended test-and-seal program to reduce infiltration and the leaky manhole repairs, and no additional infiltration increases from future deterioration of the system. Unless the municipalities implement a program of periodic re-evaluation and repair of the sewer system as recommended in Section X, this last assumption may be overly optimistic. However, the projected 30 percent decrease in infiltration resulting from the test-and-seal process is in conformance with USEPA Guidelines of 1980, which indicated that, generally, the test-and-seal procedure may cost-effectively eliminate about 30 percent of the systemwide infiltration.

Inflow. The estimated present normalized average inflow, including indirect inflow, is 0.06 mgd. The I/I Analysis, as modified in 1979, indicated a direct inflow of 0.04 mgd. It is estimated that the additional 0.02 mgd is indirect inflow from basement drains, foundation drains or non-specified storm interconnections. It is likely that the indirect inflow was identified as peak infiltration in 1979, leading to a higher estimated infiltration at that time than at present.

The projected design inflow (0.048 mgd average, 2.35 mgd peak) is based on the potential inflow reduction (0.012 mgd average, 1.25 mgd peak) resulting from the recommended programs to test and seal joints to reduce indirect inflow, to disconnect drains and cross-connections and to replace floodprone manhole covers. This 35 percent reduction of peak inflow appears reasonable when it is considered that the recommended program does not provide for reducing any inflow from the following sources.

a) Manhole covers in non-floodprone locations

b) Foundation drains

c) Trapped basement drains or sump pumps

d) Inflow through gaps in the masonry of manhole chimneys.

These sources may collectively admit about half of the present peak inflow entering the RERC-JM system.

Residential Base Flow. The estimated present average sanitary base flow from residences in the Service Area (1.59 mgd) is based on the estimate in the I/I Analysis. Based on 1980 Census data, this flow is about 76 gpd per capita. The municipal per capita rates are about 15 percent higher in Carlstadt and East Rutherford and about 15 percent lower in Rutherford. These estimates per capita residential rates are reasonable based on the 81 gpd per capita residential flow, which is typical for the total BCUA Service Area.

The projected design residential base flow (1.65 mgd average) is based on 950 additional residents locating in the Carlstadt and East Rutherford portions of the Service Area. The 0.06 gpd average residential flow increase is based on the USEPA criteria of 65 gallons per capita for projected population increase.

Non-Residential Employee and Commercial Flow. A major portion of the Service Area land is used for business enterprises. An estimated 14,200 workers were employed in the Service Area in 1978. Studies in the BCUA I/I Analysis indicated that 25 gpd per employee is a reasonable allowance for all flow from non-residential sources except industrial process wastewater. Based on this allowance, it is estimated that the average employee-commercial base is about 0.36 mgd. This includes flow from offices, stores, restaurants, schools and the non-process wastes from industrial firms.

The projected average design flow from these sources, 0.45 mgd, is based on the USEPA guidelines which allow a projected increase of up to 25 percent without detailed documentation. Based on the connection of the new 13-story Kingsbridge office complex in southern Rutherford, the probable non-residential development of the vacant property south of Paterson Plank Road in Carlstadt and the overall increase in commercial activity engendered by the Sports Complex, an increase of 0.09 mgd appears reasonable.

Industrial Process Wastewater. The industrial process wastewater is the most difficult component of the base flow to estimate. Year-to-year fluctuations based on the economy and seasonal fluctuations are large. When user charges are based on unmetered, flows estimated by the industries, the estimates are likely to be low. It is estimated that the present average flow of industrial process waste is about 0.61 mgd. This is 0.18 mgd higher than the prior estimate included in the 1981 BCUA I/I Analysis. The reason for this increase is that the high night flows monitored in Carlstadt's industrial areas, which were previously identified as infiltration, were determined during the flow isolation to be industrial flow.

The projected industrial wastewater flow is 0.69 mgd. The projected increase is less than the 25 percent allowed by USEPA criteria; however, in the County, during the past 15 years, there has been a decrease in industrial process wastewater from existing industries, and very few industries which discharge large quantities of industrial process wastewater have located in the County. As about 85 to 90 percent of the industrially zoned land is presently developed, the estimated increase of 0.08 mgd appears reasonable.

SECTION V

DESIGN PEAK FLOWS AND FLOW VARIATIONS

Peak Flow Variables. The ratio of design peak flow to average flow is dependent upon the following variables:

1. The frequency that the design peak may be exceeded.

2. The location the designed facility within the sewer system.

3. The ratio of high peaking I/I components to low peaking sanitary base components in the average flow.

4. The duration over which the peak will occur.

A series of curves, developed to calculate the proper peak to average ratio based on combinations of these variables, was used to verify the peak flows noted in Table IV-2.

Peak Frequency. The design peaks indicated in this Report are not expected to be reached more than once in a ten-year period. If more frequent exceedence were permissible, the design peak would be reduced. For example, for a design criteria of exceedence every five, two or one years, the respective design peaks would be reduced about 5, 13 or 25 percent. These estimates were based on an extensive study of peak flows in the BCUA area since 1970 and the hydrological conditions which caused the peaks. They take into account the major increase in months with high precipitation which has occurred since 1971, as Table V-1 indicates.

TABLE V-1

ANALYSIS OF MONTHLY RAINFALL*

Condition	Rainfall Range (in.)	Percent of Months 1941-71	1971-83
Very Dry	0.00-0.99	4.2	2.8
Dry	1.00-1.99	18.3	14.6
Average	2.00-5.49	67.0	54.1
Wet	5.50-8.99	9.7	19.5
Very Wet	9.00-14.49	0.8	9.0

*Central Park Rain Gage

Many of these recent very wet months have occurred during the cool weather months when groundwater levels were high prior to the heavy rainfall. High rainfall months before 1971 were confined to the summer when groundwater is low. The peaks developed based on this more recent precipitation and flow data are necessarily higher than peaks which may have been developed based on pre-1971 precipitation and flows.

System Location. Peak-to-average flow ratios for downstream facilities are less than for upstream facilities. The amplitude of short-term inflow peaks and diurnal base flow peaks are truncated by mixing with flows from other parts of the system generated at different times of day.

The facilities being designed and evaluated in this Report are downstream facilities. The time of travel to the RERC-JM Plant averages from one to two hours and the time of travel to the BCUA Plant averages from four to eight hours. Based on curves relating the effect of time of travel to total average flow, the additional peaks experienced at the BCUA Plant resulting from the

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Flow Components. The percentage of I/I in the average flow has a major effect on the peak-to-average ratio. A reduction of the I/I from 30 to 15 percent of the average flow results in a reduction of the overall peak-to-average ratio by about 35 percent. In the RERC-JM Service Area, the recommended reduction of the I/I from 26 to 18 percent of the total flow has the effect of lowering the design peak-to-average ratio by about 19 percent.

Component Peaks. Evaluating the total peak flow reduction resulting from eliminating the I/I from a specific small source by estimating the change in the overall peak-to-average ratio is a circuitous procedure. The more direct, although slightly less precise, method of adding the typical coincident peaks of the various flow components was used in this Report to determine design peaks and the peak flow reductions resulting from I/I reductions. Studies at the BCUA Plant indicated that a reasonable estimate of the 10-year peak could be calculated by multiplying the average base by 1.5, the average infiltration by 10 and the average typical inflow by 60 (but where distinguishable, the direct inflow by 120 and the indirect inflow by 30). These factors were generally used in determining the peak flows listed in Table 1 and the peak I/I reductions indicated in the subsequent tables. However, to account for the peak at the RERC-JM Station being slighly higher than the peak increase at the BCUA Plant, the non-residential base flow was multiplied by 3.0 rather than 1.5 in determining the peak flow at the RERC-JM Station. Table V-2 indicates the peak-to-average ratio for each flow component used in this Report.

TABLE V-2

RATIO OF DESIGN PEAK-TO-AVERAGE FLOW BY COMPONENT

Flow Component	Peak to Average Ratio
Residential Base	1.5
Non-Residential Base	3.0
Infiltration	10
Inflow	60
Indirect Inflow Reduction	-30
Direct Inflow Reduction	-120

Base Flow Peaks. The relatively low ratios of peak-to-average sanitary base flows are based on an analysis of the longer term base flow variations and the diurnal flow pattern recorded at the RERC-JM Plant.

Day-to-day variations in the base flow are relatively minor in comparison with the extensive day-to-day variations in the I/I flow. The analysis of long-term BCUA base flow patterns indicating the maximum variations resulting from specific causes is summarized on Table V-3. These variations also appear typical for the RERC-JM Service Area based on an analysis of RERC-JM flows metered at the Plant.

TABLE V-3

LONGER TERM BASE FLOW VARIATIONS

Cause	Percent of Average Base
Weekday - Non-Residential	120
Extended Heat Wave	115
Weekend - Residential	110
Weekday - Residential	96
Voluntary Conservation	85
Mandatory Conservation	70
Weekend - Non-Residential	50

The expected higher variation in non-residential flow over residential flow was based on the limited number of hours per week that typical commercial industrial establishments are open.

The diurnal RERC-JM base flow pattern does not vary extensively from day to day. On weekdays, the RERC-JM base flow increases from a stable minimum extending from 2 to 6 a.m. to a primary peak about 9 a.m. Flow remains near peak, about 1.5 average, throughout the morning as industrial commercial flow replaces the earlier residential peak. Flow declines slightly after noon but remains at the relatively high level until 9 p.m. as the secondary residential peak replaces the industrial flow. After 9 p.m., flows decrease slowly until midnight, then rapidly after midnight to the minimum value at 2 a.m. On weekends, the pattern reflects later risings and less employee and industrial flow, with the morning flow increasing slowly, reaching a daily peak around noon.

The amplitude of the diurnal pattern varies inversely with the size of the area served. In an upstream collector sewer, the instantaneous base flow ranges from 0.15 to 4.0 times average; at the RERC-JM Plant, base flow ranges from about 0.35 to 2.0 times average; and at the BCUA Plant, base flow ranges from 0.5 to 1.5 times the average. The lower ranges of base flow variation at the downstream facilities result from long time differential between downstream and upstream sewage peaks reaching the plants.

<u>I/I Peaks</u>. The day-to-day variation of I/I and the variation of I/I throughout the year is extensive ranging from near zero during late summer droughts to ten times average after an extensive period of wet weather in the cool months. The relatively high amplitude of the peak infiltration is the result of most sewers being above the groundwater level for most of the year. However, during extended periods of rain during the cooler months, ten times as many system defects may be submerged by

either a raised groundwater table or subsurface drainage percolating through the porous fill in the sewer trenches.

The large ratio of the design peak to annual average inflow results because inflow rates are roughly proportional to precipitation rates. The annual average precipitation rate is 0.005 inch per hour, but for over 90 percent of the time, the actual precipitation rate is zero. When rain does occur, it occurs at higher rates. Specific hours with more than one inch of rain occur several times each year. Direct inflow peaks are much higher than indirect peaks since direct inflow includes immediate surface drainage. System position has a major effect on the amplitude of the design peaks from direct inflow source. The instantaneous upstream peak may be 2000 times the annual average flow from the source, or about 20 times more than the design peak from this source at the RERC-JM and BCUA Plants.

A more extensive study of the typical peak to average I/I rates in the general area is included in the 1981 BCUA I/I Analysis and SSE Report.

<u>Extended Peaks</u>. The design peaks in this Report are the maximum flows expected for a continuous duration of several minutes in a 10-year period. However, longer duration peak also requires definition. An estimate of the maximum daily flow is required to design pump cycles at the Pumping Station. USEPA guidelines require unit infiltration rates to be expressed in terms of seven-day maximum (which was determined to be 6.0 times average in the BCUA and RERC-JM systems). NJDEP requires that treatment plants processes be designed to handle the expected increase in 30-day maximum flow.

Table V-4 indicates an estimate of these extended peaks on the basis that the sewer system has capacity to convey all the peak flows. The present extended peak flow estimates were based on typical peak to average ratios for flow components for extended periods. The estimated extended period peaks at design condition are based on the projected 31 and 35 percent decreases in the infiltration and inflow peak and the projected 11 percent increase in the sanitary base flow peak, indicated in Table 1.

TABLE V-4

EXTENDED PEAKS FROM THE RERC-JM SEWER SYSTEM

PRESENT CONDITION

Period	Extended Peak Factors x Average Flow Component (mgd)			
	Infiltration	Inflow	Base	Total
Max. 30-day	4x0.80=3.20	6x0.06=0.36	1.0x2.56=2.56	6.12
Max. 7-day	6x0.80=4.80	15x0.06=0.90	1.1x2.56=2.82	8.52
Max. 1-day	9x0.80=7.20	50x0.06=3.00	1.2x2.56=3.07	13.27

DESIGN CONDITION

	Present Extended Peak (mgd) x Ratio of Design to Present Peak			
Max. 30-day	3.20x0.69=2.21	0.36x0.65=0.23	2.56x1.11=2.84	5.28
Max. 7-day	4.80x0.69=3.31	0.90x0.65=0.58	2.82x1.11=3.13	7.08
Max. 1-day	7.20x0.69=4.97	3.00x0.65=1.95	3.07x1.11=3.41	10.33

Effect on Facility Sizing. The peak design flows in this Report are essentially the same as the flows for which the facilities were designed. However, the flows do differ from the flows indicated in the 1977 Facility Plan. At that time, the facilities were planned for a larger service area with present flows of 3.8 mgd average, 10.0 mgd peak and projected design flow of 7.5 mgd average, 17.5 mgd peak. Based partly on the projected 21 percent decrease in design peak flow if the I/I is eliminated and the 50 percent lower average design flow, the final facilities design was modified from the design indicated in the Facility Plan as follows:

1. The diameter of the force main was reduced from 27 to 24 inches.

2. At the Berry's Creek crossing, the force main was designed above ground on the Route 20 bridge abutment to avoid excavating in Berry's Creek.

3. The pumping station pump and equipment sizes were revised using the following criteria:

   a. A single, smaller, variable speed pump to convey all flow on days when the I/I is not high.

   b. Each of two larger pumps to singly convey all flow up to 13.8 mgd.

   c. The two larger pumps operating in parallel or a single larger pump operating with the aid of polymer injection to convey flow up to 17.5 mgd with a total dynamic head of 180 feet. Polymer injection may be unnecessary after the excessive peak I/I is reduced.

In 1982, a more detailed Engineering Report, describing the current facility design criteria, was submitted for NJDEP review, along with plans and Contract Documents.

SECTION VI

IDENTIFYING SEWERS WITH EXCESSIVE I/I

Overview. One of the main objectives of the Sewer System Evaluation was identifying specific sewers which admit excessive infiltration. This is the second step of the following cost-effective, three-step program designed to eliminate the largest portion of the excessive I/I tributary to the proposed BCUA RERC-JM Extension:

Step 1. Monitoring minisystem flow to determine the normalized unit infiltration rates in 22 sewer subsystems, each including about 2.2 miles of sewer.

Step 2. Flow isolation metering of short sewer reaches in minisystems with excessively high unit infiltration rates, to determine the normalized unit infiltration rates in each sewer reach.

Step 3. Performing the following sequential tasks in sewer reaches with excessively high unit infiltration rates in a Test and Seal Contract.

a. Cleaning the sewer reach;
b. inspecting the sewer reach with a TV camera;
c. pressure testing each sewer joint for water tightness; and
d. sealing with grout, each joint which fails the pressure test.

The description of the initial minisystem metering and the flow isolation methodology are included in this Section. The basis for determining the minimum excessive infiltration rate is included in Section VIII. The cost-effective test-and-seal program is discussed in Section IX and noted on Plate 3.

Also included in Section VI is a description of the investigations to locate sewers admitting excessive indirect inflow. These sewers are also recommended for inclusion in the test-and-seal program.

Initial Metering. In 1976, the 48 miles of sewer tributary to the RERC-JM Plant were divided into 22 minisystems. The early morning flows in each of these minisystems were metered four times during the winter of 1976 at times when the infiltration rates were higher than average. These meterings, in conjunction with BCUA and RERC-JM plant flows, Saddle River flows and groundwater probes, were used to determine the normalized unit infiltration rates in each minisytem. In the Facility Plan, I/I Analysis, the 11 minisystems with the highest unit infiltration rates were recommended for inclusion in a flow isolation program designed to locate specific sewer reaches with excessive infiltration. The general location of the 11 minisystems is indicated on Plate 1. The infiltration rates, based on the initial metering and the currently estimated minisystem infiltration rates, are presented in Table 2 of this Report. Based on the currently estimated infiltration, all these minisystems have unit seven-day maximum infiltration rates in excess of 5000 gpd per inch-mile.

Flow Isolation Metering. Based on the NJDEP's approval of the recommended flow isolation program and USEPA's funding of the project, the BCUA conducted flow isolation metering in RERC-JM Minisystems A, B, D and F in Carlstadt; J in East Rutherford; and M, N, P, Q, R and U in Rutherford. The results of the isolation metering are included in Tables 3a-A through 3a-U.

Isolation Methodology

Purpose of Isolation. The purpose of BCUA's Flow Isolation Program was to determine the normalized unit infiltration rate, "ni," in each sewer reach of the 11 RERC-JM minisystems with the overall highest unit infiltration rates.

Sewers with "ni" greater than "ni-min," the minimum unit infiltration rate for overall cost-effective infiltration reduction, were recommended for inclusion in a Test and Seal Contract designed to reduce the excessive infiltration.

Normalized Unit Infiltration Rate, "i". The normalized unit infiltration rates, "i," were calculated by the following equation:

$$ni = K \times (Q - B)/G \times Lt$$

where:

- ni = normalized unit infiltration in a specific sewer
- K = the ratio of normalized peak or seven-day-max infiltration to normalized average infiltration
- Q = the spot metered sewage flow in the isolated sewer reach
- B = the base flow in the sewage at the time of metering
- G = the Groundwater Index, the ratio of infiltration at the time of metering to normalized average infiltration
- Lt = the diameter-length of the isolated sewer reach including building connections.

In Tables 3a-A through 3a-U, the sewer reaches in each isolated minisystem are listed in order of normalized seven-day maximum unit infiltration rate.

Ratio of Peak or Seven-Day-Maximum to Average, "K". As noted in Section V, the day-to-day infiltration in a typical sewer in the RERC-JM system fluctuates from a minimum of practically zero to a peak of ten times the annual average, depending on the groundwater conditions at the time. Analysis also indicated that during a maximum seven-day period, the infiltration is typically six times the average flow. Since the USEPA had previously required that unit infiltration rates be expressed in terms of seven-day maximum, the value of the "K" is 6.0.

Spot Metered Flow in Isolated Sewer Reaches, "Q". Each isolated minisystem was subdivided into numbered sewer reaches, each reach averaging about 400 feet in length. The measurement manholes in all reaches were preliminarily inspected to determine suitability for metering and to confirm the system configuration and sewer dimensions. When preliminary inspection indicated that the intermediate manholes were not physically suitable for flow measurement, lengths in excess of 400 feet were used. The flow at the downstream manhole of each reach was metered using clear plastic weirs, with vertical calibrations in gpd. The plastic weir, encased by a metal frame, was wedged into the end of the outlet pipe. Flows were measured between 2 a.m. and 6 a.m., on rain-free nights during periods when there were indications that the infiltration in the sewer would be higher than its long-term average. Specifically, the flow was metered in April 1982 and April 1983. Tables 3a-A through 3a-U indicate the net metered flow and the dates that the flow was metered.

When the flow upstream of the reach being metered was expected to be more than half of the monitored flow, the upstream flows were generally blocked, using inflatable rubber plugs. Upstream flows were only blocked in locations where the upstream sewers had sufficient volume to store 30 minutes of night flow, without causing excessive surcharging. Generally, 15 to 30 minutes elapsed between the plug installation and the final reading of the weir, allowing time for the isolated flow to stabilize behind the weir. When the weirs were read, noticeable flow surges caused by toilet flushes or industrial discharges were disregarded.

Two types of weirs were used, a 90° V-notch weir, manufactured by N.B. Products, and combination 90° V-notch, topped by a rectangular weir, manufactured by Thel-Mar Industries. The weirs have the following capacities.

Diameter (in.)	N.B. Weirs (gpd)	Thel-Mar Weirs (gpd)
8	17,000	124,000
10	36,000	240,000
12	75,000	362,000
15-48	206,000	620,000

The Thel-Mar weirs were used to meter higher flows, and the N.B. weirs were used to meter very low flows.

Base Flow at the Time of Isolation, "B". The reason for isolating and metering the sewage flows in the pre-dawn hours is that, between 2 a.m. and 6 a.m., the base flow discharge from the buildings served is a small fraction of the base flow at any other time of the day. In short reaches where individual surges can be detected and discounted, the flow rate is about 15 percent of the daily average base flow rates, or about 30 gpd per dwelling unit. Farther downstream, where surges cannot be detected and discounted, the night base flow is a higher percentage of the daily average. At significant junctions within the minisystem or at the outlet of major industrial complexes, the estimated night base was 22.5 percent of average. At the minisystem outlet, the estimated night base was 30 percent of average.

Tables 3a-A through 3a-U indicate the night base estimated for each reach and the net metered infiltration, which is the metered flow, Q, minus the night base flow, B. In most instances, the night base flow was relatively small in comparison with the measured flow so that inaccuracies in the estimated night base would not significantly affect the calculated metered infiltration.

Groundwater Index, "G". As previously noted, the infiltration rate in a typical reach during the course of a typical year may vary from zero to ten times its long-term average. To convert metered infiltration on a specific day to normalized average infiltration, a Groundwater Index, "G," was determined for each day that the flow was monitored. This Groundwater Index represents the ratio of the estimated infiltration on the day of metering to the long-term average infiltration. "G" was estimated by calculating the Groundwater Index of parallel flow systems with the following characteristics:

1. A readily determinable flow and I/I rate on the night of metering.

2. A known long-term normalized I/I rate.

3. Affected by the same weather pattern as the spot metered reach.

The unadjusted Groundwater Indices, "G," in Tables 3a-A, B, D, F, J, M, N, Q and R were determined from the weighted average of the calculated Groundwater Indices of parallel systems determined by the following meters:

1. The RERC-JM Plant meter (when working properly).

2. Other continuous BCUA field meters in the vicinity of the RERC-JM Area.

3. The BCUA Plant meter.

4. The continuous meter monitoring flow in the Saddle River at Route 80 in Lodi.

The normalized average infiltration rates in these tables were determined by dividing the metered infiltration by this Groundwater Index. Because of the large, ten to one, extrapolation ratio required to obtain normalized peak infiltration rates, metered infiltration obtained when the unadjusted "G" was less than 1.0 were generally not used.

Adjusted Groundwater Index. In some minisystems, the normalized average infiltration based on the sum of the rates of each reach of the minisystem spot metered in 1982 was substantially lower than the rate for the minisystem based on valid 1976 metering. In these minisystems, the flows at the minisystem outlet and at major internal junctions of the minisystem were re-metered in the spring of 1983. In Minisystems P and U, the recalculated normalized rates, based on 1983 metering, confirmed that the 1982 metering results were too low. Accordingly, the 1982 Groundwater Indices were adjusted as follows:

$$GA = GO \times NIR/NIJ$$

where:

GA = adjusted Groundwater Index

GO = originally calculated Groundwater Index for the 1982 metering

NIR = the normalized infiltration tributary to the junction or outlet, based on the sum of the 1982 metering results normalized by the use of GO

NIJ = the normalized infiltration tributary to the junction or outlet, based on 1983 metering.

Tables 3a-Pa and 3a-Ua indicate the results of the 1983 junction and outlet metering in Minisystems P and U.

For these minisystems, "GA," rather than "GO," is listed in Tables 3a-P and 3a-U and was used in calculating the tabulated normalized infiltration rates. The effect of the adjustment is to distribute the additional normalized 1983 infiltration to the reaches in proportion to the percentage of junction infiltration in each reach based on 1982 data. The "GO" for a specific reach may be calculated by multiplying the "GA" by the adjustment ratio, "NIJ/NIR," for the junction in which the reach is included, as listed in Tables 3a-Pa and 3a-Ua.

Diameter Length, "Lt". To determine the normalized unit infiltration rates listed in Tables 3a-A through 3a-U, the normalized infiltration was divided by the diameter-length of the municipal, RERC-JM and building connection sewer in the isolated reach. This diameter-length, "Lt," was determined by the following equation:

$$Lt = (D \times L) + (b \times d \times 1)$$

where:

D = the internal diameter of the municipal sewer reach isolated, as verified in the field prior to metering

L = the length of the municipal sewer reach isolated, as verified in the field prior to metering

b = the number of building connections tributary to the reach

d = the internal diameter of the building connections, estimated to be four inches unless otherwise noted

l = the typical length of building connections generally based on the setback of the buildings from the centerline of the street.

Tables 3a-A through 3a-U indicate the dimensions "Lt, L, D, b and (b x l)" for each reach in which the flow was isolated.

Indirect Inflow Investigation. The dyed water testing program identified specific sanitary sewer reaches which either admit indirect inflow or leak into the storm system. This program complemented the flow isolation program which identified specific sewers with excessive infiltration rates. Sewers were included in the dyed water testing program if smoke from the sanitary system, released during the smoke testing described in Section VII, was observed in the adjacent storm system, but no visible cross-connection was observed. During the dyed water test, the system at the higher elevation was plugged and flooded with dyed water. Outlet manholes of the lower system were observed for the presence of dyed water which indicated an unacceptable migration of flow between the two systems. Table 3b indicates the specific sewers in which the results of dyed water tests were positive. Repair of the these sanitary sewers using the test and seal procedures is recommended if the television inspection preliminary to the joint testing indicates no direct cross-connections.

d = the internal diameter of the building connections, estimated to be four inches unless otherwise noted

l = the typical length of building connections generally based on the setback of the buildings from the centerline of the street.

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SECTION VII
I/I SOURCE DETECTION

Background. Recent evaluations have indicated that the peak I/I entering a separate sanitary sewer from readily identifiable I/I sources such as surface drains, floodprone manhole covers and leaky manholes constitute a minor portion of the peak I/I. However, these sources are generally not difficult to identify and the cost of eliminating the specific source of I/I is generally not high.

During the I/I Analysis in 1976, the DPW Superintendent or Engineer for each municipality and the RERC-JM was interviewed to identify any specific sources of I/I of which they were aware. By 1984, many of these sources had been corrected by the municipalities. Roadway improvements in areas previously identified as floodprone eliminated street flooding and most of the inflow entering the sanitary system through manhole covers in those areas.

The BCUA program to identify specific I/I sources during the SSE had two main phases, manhole inspection and smoke testing. The methodology used and purposes of these phases are described in this Section.

Manhole Inspection. Prior to the smoke testing, every accessible manhole in the 48-mile system was located, opened and inspected. Solid orange dots on Plate 2 indicate all the manholes which were inspected. Manholes not noted with an orange dot were either inaccessible at the time of inspection, sealed or paved over.

The purpose of the manhole inspection was to detect obvious sources of I/I, determine the general and structural condition of each manhole; and verify the configuration of sewer reaches indicated on available sewer maps. Obvious sources of I/I, for which the manhole was inspected, included covers located in a sump, gutter or floodprone area; leaks in the manhole wall; or a pipe from a drain or other possible inflow source. Leaks and floodprone manhole covers are indicated on Plate 2 and Tables 4c and 4d. Data gathered on the structural and general condition of the manhole included the manhole accessibility, depth, construction material, rung condition, cracks and the presence of noxious gases or evidence of surcharge. Specific structural problems are noted in Table 6. Information recorded to verify the system configuration included manhole location, pipe configuration, pipe diameters, the length of each sewer reach and the pipe number of buildings tributary. The sewer map on Plate 2 includes all corrections in location, diameter and configuration which were noted during the manhole inspection.

The manhole inspection in minisystems not scheduled for flow isolation was confined to recording the above conditions. Generally, in these manholes, conditions could be determined by aboveground inspection without descending into the manhole. In the 11 minisystems which were flow isolated, additional items of data were recorded which required descent into the manhole. The additional data observed inside the manhole included flow and deposit depth, bench condition, pipe material and any possible obstruction to weir installation or TV camera entry. These conditions are noted in Tables 3d through 3f for the sewers recommended for inclusion in the test-and-seal contract(s). In flow isolated minisystems, additional reach dimensions measured included the reach length and the number, type and setback distance of tributary buildings. These dimensions were needed for the calculations to determine the normalized average unit infiltration in each reach.

Smoke Testing. In the I/I Analysis, it was indicated that the smoke testing of the entire 48-mile sewer system would probably be a cost-effective method of identifying a portion of the illicit sources of inflow connected to the system. Upon NJDEP concurrence and USEPA funding, the smoke tests were performed during the late spring and early summer of 1982.

The smoke test procedure consisted of igniting a smoke bomb in pre-selected manholes, operating a blower to force the smoke through the connected sanitary system and observing the buildings and surrounding surfaces tributary to the smoke-filled sewers for signs of smoke exhaust. The highly visible smoke was a relatively non-toxic, non-staining zinc chloride compound. Each five-minute ignition produce enough smoke to fill all the connected sewers within 300 feet of the ignition manhole. Prior to the testing, the specific ignition manholes were selected on the basis of testing the entire system with a minimum of duplication.

Sources detected by the smoke included directly connected drain inlets, storm system cross-connections, roof drains, yard drains and untrapped basement fixtures. The smoke also indicated indirect inflow migrations and the approximate location of potential leaks in the municipal or building sewers if the groundwater table was below the sewer at the time of the test. After each test, the catchment area and the surface imperviousness was estimated for each drain detected to quantify the inflow admitted. When a sewer reach with the potential of admitting indirect inflow was detected, that reach was dyed water tested, as described in Section VI. When smoke entered a basement, the building was entered to determine whether an illegal basement drain was connected. In the RERC-JM, all cases of smoke entering the building were caused by untrapped plumbing fixtures, rather than open basement drains. The confirmed I/I sources located during the smoke test are noted in Tables 3b, 4a, 4b, 5a, 5b and 6. The locations of these sources are also indicated on Plate 2.

Prior to starting the smoke tests, an extensive public information campaign was initiated. The police and fire department were kept informed, on a day-to-day basis, of the location of the test, and CB radio communication between these departments and the smoke test crew was established. About one week before the tests were scheduled in each minisystem, BCUA notices were hand-delivered to each building connected to the sanitary system. The edited text of this notice read as follows:

"To All Area Residents:

NOTICE
SEWERS IN THIS AREA WILL BE
SMOKE TESTED
ON OR ABOUT (DATE)

The BCUA plans to smoke test the sanitary sewers in this area on the date indicated above. The smoke tests, required by Federal regulations, will detect sources of storm water inflow which could overload the BCUA System Extension, which will serve this area.

The smoke used is relatively harmless and will leave no residue to damage the interior of buildings, but all smokes are irritating to nasal passages. This irritation is temporary and quickly disappears after exposure has ceased. The smoke will not enter a building unless there are plumbing defects. These defects may presently be admitting malodorous and dangerous sewer gases into the building. To insure that smoke does not enter your building, please follow the instruction on this notice.

If smoke should enter your building, avoid unnecessary exposure to the smoke by opening as many windows as possible to clear the smoke. Then please report the smoke entry immediately to the men conducting the tests or to the BCUA consultants at (CBA phone number).

The following should avoid the risk of being exposed to smoke:

a. lung and heart disease sufferers
b. house-confined invalids
c. sleeping shift-workers
d. locked-in pets

To request special notification at the time of the testing, please call (CBA phone number).

To protect against smoke entering your building, check your building traps and cleanouts. If they are not tightly sealed, smoke may enter your building during the test. Also, pour a gallon of water into any sinks or drains which are not frequently used to fill the traps under those fixtures."

<u>Overflow Investigation</u>. The source detection efforts also detected two emergency overflows which relieve the Rutherford sanitary system. The location of these overflows are indicated in Table 4b. When Rutherford's sanitary trunk sewer surchages, the excess flow is diverted to the storm drains or ditches which empty into Berry's Creek. During periods of intense rainfall, the

cross-connections may also admit storm drainage into the sanitary system.

Future Television Inspection. Based on the recommendations of this Report, the joints in about ten miles of sewer may be tested and sealed. Prior to the testing and sealing, the sewers are cleaned and internally inspected. This inspection may disclose several additional direct sources of I/I besides the leaky joints.

SECTION VIII
COST-EFFECTIVE I/I REDUCTION

Cost-Effectiveness. I/I reductions are cost-effective if the cost savings resulting from the potential peak and average I/I reduction exceed the cost of the repair. A cost-effective analysis requires the quantification of the following items:

a. the unit cost savings per gpd that the peak and average I/I is reduced;

b. the potential peak and average flow reductions resulting from specific repairs;

c. the cost of the specific repairs.

This Report includes an evaluation of overall cost-effectiveness based on USEPA criteria. However, the USEPA will apparently not be funding the repairs in the foreseeable future. This Section, therefore, also includes an analysis of the cost-effectiveness of local implementation of the overall cost-effective repairs.

Overall Benefits of I/I Reductions. The USEPA has been explicit in prescribing the cost savings to be included in an overall benefit analysis. These include the annual operating cost savings resulting from transporting and treating less average flow, as well as the capital cost savings resulting from not having to construct additional sewer and treatment capacity to handle peak flows, some of which are presently bypassed. The overall benefits are to be analyzed irrespective of the source of funding. Annual operating cost savings are to be evaluated on a 20-year present-worth basis with no allowance for inflation and a discount rate established by the USEPA at the start of the Facility Planning.

Most of the overall cost savings result from reduced additional peak flow capacity needed at the BCUA Plant, reduced additional peak flow transport capacity needed along the BCUA's Southwest Trunk Sewer and reduced BCUA Treatment Plant operating costs. Additional overall cost savings may result from reduced RERC-JM Extension Pumping Station operating costs and from a reduced diameter of the proposed RERC-JM Extension Force Main. The minor overall savings resulting from not needing 1) additional manpower to operate an enlarged plant, 2) slightly larger equipment at the RERC-JM Extension Pumping Station, or 3) additional local sewer capacity, have not been separately quantified in this Report.

In 1981, the BCUA released the I/I Analysis and SSE Report for its present Service Area. That report included a detailed analysis of the overall cost-effectiveness of I/I reductions in the BCUA area. Most of the overall cost savings noted in that report are applicable to I/I reductions in the RERC-JM Service Area. To maintain the compatibility of the overall cost-effectiveness analyses in this Report with the 1981 Report, the overall benefits and costs in all tables in this Report (except Table 1b) are presented in terms of 1981 dollars based on 1981 estimates, using the 1981 discount rate of 7.375 percent. (Updated cost estimates are used in the analysis of the cost-effectiveness of local implementation.)

The overall 1981 present-worth cost savings resulting from I/I reductions in the RERC-JM system are \$0.64 per gpd that the peak I/I is reduced, and \$0.60 per gpd that the average I/I is reduced as indicated in Table VIII-1. Since the peak potential I/I reductions are more than ten times the average I/I reductions, over 90 percent of the overall savings result from peak flow reductions.

TABLE VIII-1

OVERALL COST SAVINGS FROM RERC-JM I/I REDUCTIONS

Source of Savings	1981 $ per gpd that the I/I is Reduced: Peak I/I	Average I/I
Reduced Additional Plant Capacity	$0.50	-
Reduced Plant Operating Cost	-	$0.50
Reduced Additional Southwest Trunk Capacity	0.10	-
Reduced RERC-JM Extension Operating Cost	-	0.10
Reduced RERC-JM Extension Force Main Cost	0.04	-
TOTAL	$0.64	$0.60

Derivation of Overall Cost Savings

Cost Savings from Reduced Peak Flow Treatment Capacity Requirements. The recent BCUA plant expansion does not provide sufficient capacity to treat the present maximum coincident plant peak flows nor the extended 30-day maximum flows. The BCUA Plant is designed for a peak flow of 187.5 mgd (2.5 x average) and a 30-day maximum flow of 93.75 mgd (1.25 x average). Wet weather peaks of 282 mgd and wet-weather 30-day maximum flows of 118 mgd may be experienced after RERC-JM joins the system according to recorded plant flows, emergency overflow estimates and I/I reductions recently implemented by BCUA. Both a coincident peak I/I reduction of about 47 percent and a 30-day maximum flow reduction of about 38 percent would be required for the plant capacity not be exceeded. Because the coincident peak capacity deficiency is more severe than the 30-day maximum capacity deficiency, the overall benefit analysis has been based on coincident peak flow reduction.

To develop a unit cost savings per gpd that the coincident peak plant flow is reduced, the unit cost of additional peak flow capacity was calculated. The BCUA Plant's peak flow capacity would be increased 62.5 mgd by constructing additional grit, primary, aeration, secondary, chlorine contact and outfall facilities similar to those required for the current 25 mgd average flow capacity expansion. (Adequate main pumping and sludge processing facilities would not require expansion.) The 1981 estimated total cost of a 62.5 mgd peak capacity expansion is about $31.25 million dollars ($25 million construction, $6.25 million design, administration, inspection, finance and legal). The cost saving, resulting from each gpd that the tributary peak flow is reduced, was therefore $0.50, based on a rate of $31.25 million per 62.5 mgd peak treatment capacity.

There would also be an increase in operating and maintenance (O&M) costs if the plant was expanded. However, because the precise increase in the O&M cost is somewhat speculative and because the present-worth of the O&M increase is minor in comparison with the capital cost, the O&M increase was not assessed in this overall benefit analysis.

<u>Cost Savings from Reduced BCUA Plant and Sewer O&M Costs</u>. A past analysis of the BCUA costs indicated that about 40 percent of the O&M costs may be considered I/I flow proportional. I/I flow proportional O&M costs include the costs of operating and maintaining the BCUA sewers, plant pumping and grit facilities, circulation pumps, blowers, primary clarifiers, aeration tanks, secondary clarifiers, chlorine facilities and a small percentage of the sludge handling facilities. Based on the 40 percent estimate, the flow proportional portion of BCUA's $8.0 million 1981 O&M budget

was $3.2 million. Based on a typical average flow of 67 mgd, the annual cost per gpd of average flow was $0.048 ($3.2 million/67 gpd). The present-worth of 20 years of this annual cost discounted at USEPA's 1981 designated rate of 7.375 percent per year was $0.50 per average gpd. Based on this assessment, this Report uses a cost-savings from this category of $0.50 for each gpd that the average I/I is reduced.

Cost Savings from Reduced Additional Southwest Trunk Capacity. In the 1981 BCUA benefit analysis, a generalized benefit of $0.10 per gpd that the peak flow is reduced was assessed for all systems tributary to BCUA's Hackensack Valley Trunk Sewer System. Although nominally in this system, the Southwest Trunk Sewer discharges into the Hackensack Valley Trunk Sewer a mere 800 feet north of the BCUA Plant. Therefore, a discussion of the reasonableness of this assessment is warranted.

The RERC-JM flow will discharge into the Southwest Trunk Sewer 8200 feet west of its juction with the Hackensack Valley Trunk. The typical capacity of this 48-inch diameter sewer is about 40 mgd. A 1982 analysis indicated that the sewer would reach its flowing full capacity upon entry of the RERC-JM flow if there were no I/I reduction. This estimate was based on the inclusion of flow from Wood-Ridge, but the exclusion of flow from NAL-JM.

To handle the increasing peak from anticipated growth, some effort to increase the peak capacity is warranted. The 1981 replacement cost of the existing Southwest Trunk Sewer was estimated to be about $4.0 million, or $0.10 per gpd of peak flow capacity. Previous studies have indicated that additional capacity can be gained by the use of polymers to convey peaks, often a lower unit cost per gpd than the unit cost per gpd of the original sewer. If additional capacity is gained by a parallel sewer, which may be needed if the NAL-JM flow is included, the unit cost per gpd of additional capacity may exceed $0.10 per gpd. Since the method of achieving the additional capacity has not been determined, the estimated overall cost savings of $0.10 for each gpd of additional Southwest Trunk Sewer capacity which is not required appears reasonable.

Cost Savings from Reduced RERC-JM Pumping Costs. Reduced flows at the proposed RERC-JM pumping station will result in lower O&M costs. Based on standard cost curves for a pumping station with an average flow of 3.5 mgd and an average total head of 30 feet, the annual O&M cost of the station may be reduced about $0.01 for each gpd that the average flow is reduced. Most of this cost savings results from lower energy costs. The present worth of 20 years of this savings discounted at USEPA's designated rate of 7.375 percent per year was $0.10 per gpd that the average flow was reduced. A rate of $0.10 per gpd that the average flow is reduced is used in this analysis.

Cost Savings from Reduced Force Main Diameter. The most economical diameter of the 10,000-foot force main, proposed to connect the RERC-JM pumping station with BCUA's East Rutherford Extension Force Main, is 24 inches, based on system head curves for a design flow of 13.8 mgd. A 27-inch diameter force main could convey about 4.5 mgd additional peak flow, or 18.3 mgd, with the same loss of head. The 1981 cost of the 27-inch diameter force main could be $180,000 more than the cost of the 24-inch main. Therefore, the overall cost savings benefit based on the diameter of the new force main may be about $0.04 per gpd that the peak flow is reduced ($0.18 million/4.5 mgd). It should be noted that the effect of the potential flow reduction on the pumping station cost was also reviewed, however, the cost reduction was found to be minor and is not quantified in this analysis.

Limitations of the Overall Analysis. The overall benefit and cost-effectiveness analyses are dependent upon broad assumptions regarding typical flows, benefits, costs and flow reduction, and is not firmly fixed for the following reasons:

1) The benefit analysis in this Report is based upon the requirement of transporting the peak sustained wet weather flow, which may occur during a ten-year period, to the treatment plant and providing full secondary treatment. If lesser treatment standards were allowed, the overall cost savings from I/I reductions would also be reduced.

2) Significantly higher overall cost savings than used in this Report can be assigned to I/I reduction if the reduction can avoid construction of parallel units, rather than simply reducing the size of a needed parallel unit. The avoidance of paralleling depends upon the total capacity deficiency, the total feasible I/I reduction, the possibility of decreased transport and treatment standards and the possibility of non-structural alternatives.

3) The overall cost savings benefit is dependent upon the changing projection of Service Area growth. For example, during the late 1970's, the projected Service Area population growth between 1980 and year 2000 was reduced from 210,000 to 33,000. Accordingly, facility expansions previously planned to handle the increased flows resulting from the rapid projected growth, regardless of I/I reduction, could be indefinitely deferred if possible I/I reductions were sufficient. Thus, the reduced projection necessitated the reassessment of benefits ascribed to delaying the need for new construction.

4) The peak infiltration estimates are based upon an extrapolation of infiltration metered at above average but less than peak condition. The extrapolation, while relatively accurate overall, is not precise for a specific reach. This is because the ratio of sources admitting infiltration at the time of metering to sources admitting infiltration at peak conditions is indeterminate and can vary substantially. The general tenfold extrapolation, used to calculate peak infiltration from infiltration metered during average groundwater conditions may therefore result in a substantial inaccuracy in the peak flow estimated in a specific reach.

5) The percentage of peak and average infiltration reduced by a program such as test-and-seal has not been conclusively determined. A USEPA study, released in 1980, has indicated that early I/I analyses had substantially overestimated the potential I/I reductions.

6) The flow estimated from each detected source is based on broad assumptions regarding the actual percentage of the total time that flow will be admitted by the source.

7) The estimated rehabilitation cost is based on subjective judgments regarding the least cost "adequate" method of diverting inflow sources. For example, the cost of eliminating an inflow source is substantially less if pondage or overland flow diversion is judged permissible, rather than requiring piped diversion.

Because of these considerable uncertainties, the cost-effectiveness analyses in this Report have been based on generalized typical flows, costs and benefits of flow reduction, rather than on site-specific and time-specific flows, costs and benefits.

<u>I/I Source Flow Quantification</u>. In accordance with recent USEPA Guidelines to quantify I/I by source categories, Table VIII-2 summarizes the typical estimated flow rates assigned to the I/I sources detected.

TABLE VIII-2

TYPICAL FLOWS FROM I/I SOURCES

Sources	Annual Avg I/I (gpd)	Ratio of Coincident Peak to Annual-Avg I/I	Coincident Peak I/I (gpd)	Instantaneous Peak I/I (gpd)
†Manhole Leak (typical)	36	10	360	
†Manhole Leak (high-rate)	180	10	1,800	
†Infiltration in Metered Reach	(3)	10	(3)	
Tidal Inflow	(3)	10	(3)	
Basement Drain or Sump Pump	100	30	3,000	20,000
†Indirect Inflow in Dye Tested Reach (1)	500*	30	15,000*	
Manhole Cover in Gutter	300	30	9,000	55,000
†Surface or Roof Drain (2)	0.075*	120	9*	150*
†Typical Manhole Cover	1	120	120	2,000
†Manhole Cover in Area that Floods	75	120	9,000	100,000
†Storm Interconnection Overflow	500	120	60,000	1,000,000

† sources detected during the RERC-JM SSE

* per unit noted

(1) gpd/inch-mile

(2) gpd/sq ft tributary impervious area

(3) as calculated

Basis of I/I Quantification. Table VIII-2 summarizes the estimated annual average and coincident peak flows estimated as typical for various I/I sources. The coincident peak is the estimated sustained flow from a source during a sustained period when the flow rate at the plant is at a 10-year peak. The instantaneous peak flow admitted by many inflow sources during the peak of a cloudburst rainfall may be 5 to 20 times greater than the coincident-peak. However, most overall cost-saving benefits are assessed for reduced trunk sewer and plant peaks, thus these high short-term peaks are not reflected in the attenuated trunk and plant flow. For computational standardization, one of three coincident-peak to annual-average ratios, 10, 30 or 120 (the ratios typical for infiltration, indirect inflow, and surface runoff, respectively) was assigned to each source. The reasoning for selecting the ratio for each specific source category detected in the SSE program in the RERC-JM system and which may be located in subsequent investigations is described hereinafter.

Manhole Leaks. Sewer infiltration in the RERC-JM Service Area is highly intermittent. A typical visible manhole leak may admit infiltration only about one fourth of the total time. Sustained peak rates could be about 2.5 times higher than the average flow during periods of leakage. These estimates justify using ten, the lowest standard ratio of coincident-peak to annual-average I/I to quantify visible leaks. A typical visible manhole leak, detected during the manhole inspection, was estimated to be admitting at the time of detection, 0.1 gpm (144 gpd), the minimum rate at which leakage along a moist manhole wall can be detected. Based on the typical leak being inactive 75 percent of the time, the annual average flow would be 36 gpd, and the coincident peak would be 360 gpd. For standardization, leaks noted in the field as severe or high-rate were estimated to admit flow at five times the rate assigned to typical confirmed leaks (180 gpd annual-average, 1800 gpd coincident-peak).

Metered Reach Infiltration. As previously discussed, spot metered infiltration rates were converted to average annual infiltration. The following formula was used for this conversion:

$$nI = mI/G$$

where:

nI = normalized average reach infiltration

mI = spot metered reach infiltration

G = the Groundwater Index, which is the ratio of meter area infiltration at the time of reach metering to long-term average infiltration. For method of determination, see Section VI.

Tables 3 and 3a-A through 3a-U present infiltration rates in terms of average, seven-day maximum and coincident peaks. Based on an analysis of long-term BCUA Plant flow records, the estimated seven-day maximum-reach infiltration is six times the annual-average reach infiltration. The estimated coincident-peak reach infiltration is ten times the annual-average reach infiltration.

Basement Drains and Sump Pumps. While most sump pumps can discharge at an instantaneous rate of 10 to 15 gpm (15,000 to 20,000 gpd), a sustained basement leakage exceeding 3000 gpd (about two gpm) is unlikely in most basements subject to periodic leakage. Therefore, a rate of 3000 gpd was selected as the coincident peak. As most basements with sump pumps or drains experience leakage only a few weeks a year, a standard ratio of 30 for coincident-peak to average was considered more appropriate than 10 or 120. The estimated annual-average inflow per sump pump or basement drain is 100 gpd, determined by dividing the coincident peak, 3000 gpd, by the ratio, 30.

Indirect Inflow in Dye Tested Reaches - In recommending the dyed water flooding to test for indirect inflow, it was estimated that repair by the test-and-seal process would be cost-effective, although duplication of the saturated conditions required for quantification was not feasible. Since indirect inflow is estimated to occur a few weeks per year, a standard ratio of 30 for coincident-peak to annual-average I/I was considered more appropriate than 10 or 120. An average rate of 500 gpd per inch-mile and a peak rate of 15,000 gpd per inch-mile was assigned to any reach where a moderate migration of dyed flow migration was observed. These rates allow cost-effective flow reduction by the test-and-seal program, without assigning an excessive portion of the total area inflow to the indirect sources detected.

Manhole Covers in Gutters. Manhole covers in gutters admit runoff during periods of moderate to heavy precipitation. Since this precipitation occurs about two to four percent of the total time, a standard ratio of 30 for coincident-peak to annual-average inflow was considered more appropriate than 10 or 120. Peak instantaneous flow of 55,000 gpd with one inch submergence is possible; however, the typical submergence averaged over a sustained six-hour period is significantly less. A peak coincident flow rate of 9000 gpd and an average rate of 300 gpd may be considered typical.

Surface and Roof Drains. Peak and average runoff rates can be correlated to the rainfall rate probability and the impervious tributary area. The following peak and average precipitation rates are typical to Northeastern New Jersey:

Instantaneous Peak (10-yr)	20 ft/day (10 in/hr) (2000 x avg)
Sustained Six-Hour Peak (10-yr)	1.2 ft/day (0.6 in/hr)(120 x avg)
Long-term Average	0.01 ft/day (0.005 in/hr)

Converting these rates to gallons by multiplying 7.5 gal/cu ft yields the following runoff rates:

Instantaneous Peak	150 gpd/sq ft
Coincident Peak	9 gpd/sq ft
Annual Average	0.075 gpd/sq ft

Based upon the ratio of the ten-year peak, six-hour precipitation rate to the long-term average precipitation rate, a standard ratio of 120 for coincident-peak to annual-average flow has been used for most surface runoff sources.

<u>Typical Manhole Covers</u>. Most manhole rims and covers are slightly depressed. Typically, a foot-wide ring of pavement around the cover drains to the cover. The total area drained by the cover, including the cover plus the annulus of depressed pavement, is about 13 square feet. Based on a rate of 0.075 gpd per square foot and a standard ratio of 120 for coincident-peak to average runoff, the average inflow is one gpd and the coincident peak is 120 gpd.

<u>Manhole Covers Subject to Flooding</u>. The frequency of inundation, applicable for a typical manhole cover subject to flooding is unpredictable, often dependent on blockages in the local storm drains. A manhole cover under four inches of water can admit 95,000 gpd through the ventholes and around the rim. A coincident peak rate of 9000 gpd is used in this Report, based on the estimated low probability of each specific manhole cover noted in floodprone areas being inundated for the six-hour period of peak plant infiltration. The 75-gpd annual-average inflow per cover was calculated by dividing 9000 gpd by 120, the highest standard ratio of concident-peak to annual-average I/I used in this Report. In actuality, the ratio may be higher because of the short duration of most flooding.

Storm-Sanitary System Interconnections. A storm-sanitary interconnection can admit instantaneous rates of more than 1 mgd when the hydraulic level in the storm system is one foot higher than both the interconnection pipe invert and hydraulic level in the sanitary system. The significantly lower coincident peak used in this Report, 60,000 gpd, is based on the low probability of this head condition continuing for the six-hour period when plant infiltration is peak. The 500-gpd annual average inflow per interconnection was calculated by dividing 60,000 gpd by 120, the highest standard ratio of coincident-peak to annual-average I/I used in this Report. This high ratio is based on the short period of time when storm system surcharging occurs.

Overall Cost Savings Benefit of Specific Flow Reductions. The overall cost savings benefit formula developed in Table VIII-1 is $0.64 per gpd that the coincident peak I/I is reduced, plus $0.60 per gpd that the average I/I is reduced. Expressed solely in terms of average flow, this formula is $0.64 x coincident peak-to-average ratio + $0.60 per gpd that the average flow is reduced. Based on this formula, the cost-savings benefit for reducing base flow, infiltration, indirect inflow and surface runoff, expressed in terms of the average reduction, yet including the benefit for the associated peak reduction typical to each flow category, follows in Table VIII-3:

TABLE VIII-3

UNIT BENEFITS FROM REDUCING RERC-JM FLOW COMPONENTS

Flow Component	Typical Ratio of Coincident Peak to Annual-Avg Flow	Overall Benefit of RERC Flow Reduction*
Residential Base	1.5	1.46
Non-Residential Base	3	2.42
Infiltration	10	7.00
Indirect Inflow	30	19.80
Surface Runoff	120	77.40

*Expressed in terms of 1981 $ per gpd that the normalized average flow is reduced.

A tabulation of overall present-worth cost-savings resulting from eliminating specific sources of flow, expressed in terms of average flow reduction but based on the typical average flow and coincident peak per source, follows in Table VIII-4.

TABLE VIII-4

TYPICAL OVERALL COST SAVINGS FROM ELIMINATING RERC-JM FLOW SOURCES

Flow Component & Associated Coincident Peak	Average Flow (gpd)	1981 Typical Overall Cost Savings
Base Flow, Coincident Peak = 1.5 x residential avg		
Dwelling Unit	198	308.88
Resident	76	118.56
Employee (peak = 3 x avg)	25	49.50
Typical Infiltration, Coincident Peak = 10 x avg		
Visible Leak (confirmed typ.)	36	252.00
Visible Leak (high rate)	180	1,260.00
Metered Reach (2)	(6)	7.00*
Metered Reach (3)	-	1.17*
Tidal Inflow (2) (7)	(6)	7.00*
Typical Indirect Inflow, Coincident Peak = 30 x avg		
Basement Drain Sump Pump	100	1,980
Reach with Dye Tested Indirect Inflow (4)	500*	9,900
Indirect Inflow Reduction by Grouting (9)	410*	8,118
Manhole Cover in Gutter (8)	300	5,940
Direct Inflow, Coincident Peak = 120 x avg		
Typical Manhole	1	77.40
Manhole Subject to Flooding	75	5,805.00
Surface or Roof Drain (5)	0.075*	5.80*
Storm Interconnect - Overflow	500	38,700.00

(1) With no *, per source eliminated; with *, per unit noted in footnotes.
(2) Per average gpd.
(3) Per seven-day maximum gpd.
(4) Per inch-mile.
(5) Per sq ft of tributary impervious area.
(6) As calculated.
(7) Tidal inflow has coincident peak similar to typical infiltration.
(8) Cover in gutter has coincident peak similar to indirect inflow.
(9) Per inch-mile of trunk or lateral sewer grouted. The test-and-seal procedure is estimated to reduced trunk and lateral indirect inflow by 82 percent.

A tabulation of overall present-worth cost-savings resulting from eliminating specific sources of flow, expressed in terms of average flow reduction but based on the typical average flow and coincident peak per source, follows in Table VIII-4.

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Metered Reach (2)	(6)	7.00*
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Typical Indirect Inflow, Coincident Peak = 30 x avg		
Basement Drain Sump Pump	100	1,980
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Direct Inflow, Coincident Peak = 120 x avg		
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Manhole Subject to Flooding	75	5,805.00
Surface or Roof Drain (5)	0.075*	5.80*
Storm Interconnect - Overflow	500	38,700.00

(1) With no *, per source eliminated; with *, per unit noted in footnotes.
(2) Per average gpd.
(3) Per seven-day maximum gpd.
(4) Per inch-mile.
(5) Per sq ft of tributary impervious area.
(6) As calculated.
(7) Tidal inflow has coincident peak similar to typical infiltration.
(8) Cover in gutter has coincident peak similar to indirect inflow.
(9) Per inch-mile of trunk or lateral sewer grouted. The test-and-seal procedure is estimated to reduced trunk and lateral indirect inflow by 82 percent.

Overall Cost-Effectiveness of Specific Rehabilitations. Specific repairs to eliminate specific sources of I/I are overall cost-effective if the total cost of implementing the repair is less than the overall present-worth cost savings resulting from the I/I elimination. Tables 4a, b, c and d and 5a and b indicate the overall cost savings benefit, the cost and the benefit/cost ratio for eliminating the I/I from specific sources detected during the SSE. The tables are based on the assumption of nearly complete elimination of the I/I from the drains, floodprone manhole covers and manhole leaks detected. Costs and benefits are based on 1981 and benefits. Current costs and benefits may be about 20 percent higher.

Cost-Effectiveness of Non-Specific Test and Seal Repairs. Estimating the cost-effectiveness of I/I reductions which may be achieved by a program of testing and sealing sewer joints requires several "typical case" assumptions. The typical case assumptions used in this Report are as follows:

1. In an isolated sewer reach, the infiltration will be distributed between the municipal sewer and building connections in proportion to the diameter-length of each. Accordingly, in a specific reach, the unit infiltration rates in building connections will be the same as the unit rate in the main sewer. The basis of this assumption was discussed in the I/I analysis.

2. The test and seal program can reduce 82 percent of the I/I from the municipal sewer but none of the I/I from the building connections.

3. In older clay sewers, about one-third of the joints, assumed spaced at 2.5 to 3.0 feet, will require grouting.

4. The cost of the test and seal program is proportional to the diameter-length of sewer.

5. The percentage reduction of average flow will be the same as the percentage reduction of peak flow.

Minimum Excessive Unit Infiltration Rate, "ni-min". Based on the previous assumptions, the minimum excessive normalized seven-day max unit infiltration rate, "ni-min," of 7400 gpd per inch-mile was calculated using the following equation:

$$ni\text{-}min = k \times j \times c/(ba + kp \times bp) \times w$$

where:

ba = \$0.60/gpd of average flow. The 1981 present-worth of the cost savings in operating costs at the BCUA Plant and proposed RERC-JM Pumping Station resulting from not treating a gpd of average flow for a 20-year period.

bp = \$0.64/per gpd of peak flow in the RERC-JM System. The 1981 unit cost savings from not constructing additional BCUA trunk sewer, force main and treatment plant capacity to handle each gpd of peak flow including that which is now bypassed.

c = \$4715/in.-mi. of sewer tested and sealed. The 1981 estimated cost to test and seal the joints of an inch-mile of sewer, including the cost of the contract, contract supervision and the preparation of contract documents. This cost estimate presently appears high. (A 1984 cost of \$3536 now appears reasonable.)

j = 1.5. A factor to compensate for the possibility of lower than expected infiltration reductions. The peak reductions are somewhat more speculative than the average flow reductions. Therefore, a higher "j" is justified when most of the cost savings result from peak flow reductions.

k = 6 gpd of 7-day max infiltration per gpd of average infiltration. The ratio of normalized 7-day max infiltration to normalized average infiltration.

kp = 10 gpd of peak infiltration per gpd of average infiltration eliminated. The estimated ratio of peak infiltration reduction to average infiltration reduction achieved by the test and seal procedure. The equation is based on an equal percentage reduction of peak and average infiltration flows.

w = 0.82. The estimated efficiency of the test and seal procedure in reducing the average infiltration which enters through defects in the municipal sewer. Test and seal can not presently reduce any infiltration which enters through defects in the building connections.

Accordingly, flow isolated sewer reaches were included in the recommended test and seal program, detailed in Tables 3a-A through 3a-U and Plate 3, if the unit normalized 7-day max infiltration rate exceeded "ni-min" of 7400 gpd/in.-mi. Flow isolated sewer reaches with infiltration rates below "ni-min" were not recommended for inclusion unless the presence of indirect inflow was indicated in Table 3b.

<u>Overall Cost-Effectiveness of Specific Test-and-Seal Recommendations</u>. Tables 3a-A through 3a-U also list the following

estimated quantities needed to demonstrate the overall cost-effectiveness or non cost-effectiveness of testing and sealing each reach in the flow isolated minisystems.

1. The estimated average and peak infiltration reductions = w x normalized average or peak infiltration in reach x diameter-length excluding building connections/diameter-length including building connections.

2. The overall cost savings or benefit resulting from the flow reduction = (ba x average infiltration reductions) + (kp x bp x peak infiltration). The cost savings for the peak flow reductions will be realized at the time BCUA constructs facilities to handle peak flows which are now bypassed.

3. Test-and-seal cost = c x diameter length of municipal sewer excluding building connections. Analysis of the bids for a 1983 BCUA test-and-seal contract indicates that lower rates may be expected. These lower unit costs are indicated and used in Table 1b.

4. The net benefit = (cost savings benefit) - (test-and-seal cost).

5. The benefit cost ratio = cost savings benefit/test-and-seal cost.

These quantities are summarized in Table 3.

Cost-Effectiveness to BCUA. A project may be considered cost-effective to the BCUA if it allows the reduction of the unit user charge to its customers. If the BCUA were planning the immediate expansion of its treatment facilities and sewer system to handle all sanitary system peak flows, including those presently bypassed, then the cost-effectiveness to the Authority would be the same as the overall cost-effectiveness. In that case, implementation of the overall recommended program would result in smaller increase in unit user charges than would occur without implementation.

However, in reality, the cost of construction of all the needed facilities to convey all peak sanitary flows to the BCUA Plant and to provide full secondary treatment for the peaks may be between $50 million and $100 million, depending mainly on the I/I which may be eliminated. Such a cost is beyond the planned expenditures of the BCUA and the project would not be implemented without major grant assistance. The NJDEP has given the BCUA project of Peak Flow Facilities a relatively low priority ranking. At present funding levels, it may be 20 years before grants would be available to fund the project. Since the NJDEP has not in the past required low priority projects of this magnitude to be constructed without grant assistance, it is therefore not likely that the project will be implemented in the foreseeable future.

Without the construction of parallel Southwest Trunk Sewer and the additional units at the Plant to handle the peak flow, the benefits to the BCUA resulting from I/I reduction are severely reduced. For the foreseeable future, any cost savings resulting from reduced operating and maintenance costs of the BCUA Plant and proposed RERC-JM Pumping Station will be more than offset by reduced revenues generated by the BCUA user charge. This is because the BCUA user charges levied on the total metered flow are used to repay bonded indebtedness, salaries and other fixed costs, as well as flow proportional operating costs. Accordingly, any reduction in BCUA metered flow for the foreseeable future would result in higher unit BCUA charges, regardless of who pays for the cost of the repairs which result in the flow reductions. Therefore, it is not cost-effective for the BCUA to implement the recommended overall cost-effective program to reduce I/I at this time.

Cost-Effectiveness of Local Implementation. There are several cost savings and benefits to RERC-JM and its municipalities which result from reduced I/I flows. These include reduced BCUA user charges, fewer sewer system structural failures, fewer cases of sewer surcharges which may flood basements and streets, and fewer overflows.

In this Report, the only cost savings to the RERC-JM and its member municipalities which are quantified are the reduced BCUA user charges. In the past two years, the total BCUA unit user charge has beeen $0.264 and $0.227 per year per gpd of metered flow. This is an average of $0.245 per gpd per year. About 33 percent of this charge, or $0.081, has been assessed to the measured solids and BOD in the sewage flow. It is known that the BOD and solids in I/I, while appreciable, are significantly less than in the total sewage flow. Therefore, a present estimated BCUA unit charge of $0.200 per gpd per year ($0.164 for the clear water plus $0.036 for the pollutants and solids in the I/I) appears reasonable and is used in the analysis in Table 1b. However, as previously noted, the BCUA unit user charge will rise slightly for each gpd that the metered flow decreases. The effective net annual user charge reduction for each gpd that the I/I is reduced may be calculated by mutiplying $0.20 by (1 - 0.7 x R) to account for the increase in BCUA unit flow charge caused by the flow decrease, where 0.7 is the ratio of fixed BCUA costs to total cost and R is the ratio of municipal or RERC-JM flow to BCUA flow. The estimated charge reduction is based on the differences between implementation or non-implementation. Actual BCUA charges are also based on a number of other factors which may increase or decrease the charge.

In Table 1b, the revised 1984 costs of the I/I reduction program phases are compared with the annual savings in BCUA user charges based on the potential average flow reductions. Based on an 8-percent municipal bond interest rate, a 4-percent annual inflation of BCUA user charges and debt service repayment equal to the estimated BCUA charge reduction, Table 1b indicates the number of years required to fully pay for each phase of the recommended program.

Based on the USEPA criteria that a project which pays for itself in 20 years may be cost-effective, Table 1b indicates that local implementation of the entire recommended project may be considered cost-effective. However, some specific phases to reduce high peaking inflow may not be cost-effective by themselves because of the low average flow reduction. The most cost-effective phase is the program to test-and-seal sewer joints to reduce infiltration which may pay for itself in about seven years.

<u>Indirect Benefits</u>. While not quantified in this Report, there are additional benefits and cost savings which may increase the cost-effectiveness of local implementation of the recommended program.

Infiltration has the effect of slowly reducing the structural integrity of the sewer system. Supporting soil is washed into the system with the infiltration. Washout of supporting soil may cause the sewer, the adjacent facilities and eventually the street itself to collapse. Infiltration reduction therefore can prolong the structural life of several municipal systems.

Peak I/I, which may overload the local interceptors and trunk sewers, is a major cause of surcharge and sewage backups into basements. Although the cost savings from not needing additional local sewer capacity has not been quanitified in this Report, reduction of peak municipal I/I will reduce the frequency of surcharges and thus reduce the cleanup costs, the personal losses and the health hazards resulting from sanitary sewage backups.

Discharge permits from the NJDEP may be required for emergency overflows which relieve surcharging caused by peak I/I. The permits generally require the municipality to eliminate the need for the overflows by constructing parallel sewers or other methods. Reducing the I/I which causes surcharge is often the most economical method of eliminating the need for the emergency overflow.

During the test-and-seal program, the television camera used in the internal sewer inspection may detect a number of badly dilapidated sewer sections. Using this knowledge, the municipality may make timely repairs before the sewers collapse and more expensive emergency repairs are needed.

SECTION IX

RECOMMENDED LOCAL IMPLEMENTATION

Overview. Table IX-1 summarizes the recommended I/I reduction program which is overall cost-effective.

TABLE IX-1

RECOMMENDED I/I REDUCTION PROGRAM

Rehabilitation Procedure (I/I Component Reduced)	1984 Cost ($1000)	For Details See Table	Plate
Test-and-seal sewer joints (1)	342.4	3aA-U	3
Test-and-seal sewer joints (2)	18.2	3b	3
Diverting storm drains (3)	64.8	4a	2
Valving cross connection (3)	15.0	4b	2
Repairing manhole leaks (1)	6.4	4c	2
Manhole cover replacement (3)	1.4	4d	2
Disconnecting roof drains (3)	2.5	5a	2
Disconnecting yard drains (3)	2.3	5b	2
TOTAL	453.0	1b	

(1) Infiltration
(2) Indirect Inflow
(3) Direct Inflow

Implementation. It is not presently cost effective for the BCUA to implement the rehabilitation for reasons indicated in Section VIII. It does appear cost-effective for the RERC-JM or its municipalities to implement these repairs. It is therefore recommended that the rehabilitation phases summarized in Tables 3 and 4 be implemented locally by either the RERC-JM or its municipalities. It is also recommended that the property owners be requested to implement the recommended rehabilitations on their property, noted in Tables 5a and b.

RERC-JM Billing System. Under standard situations, the BCUA bills the municipalities on an annual basis for the municipal flow suspended solids and BOD, as metered by BCUA in accordance with the user charge. However, under terms of the current agreement with the RERC-JM, the BCUA may bill the RERC-JM for the total flow and the RERC-JM may bill its participants. Whether the RERC-JM will distribute the charge to its municipalities on the basis of municipal flows as determined by the BCUA meters to be installed, or on the current basis of one-third of the total to each municipality, is to be determined by the RERC-JM. In the future, BCUA may revise its method of billing and bill each municipality directly, if each of the three municipalities executes a separate contract with the BCUA.

Advantages of RERC-JM Implementation. An advantage of RERC-JM implementing the recommended repairs is that the RERC-JM is not subject to New Jersey's Municipal Cap laws and the considerable administrative cost of gaining approval of budget increases of over five percent per year. The RERC-JM may also be able to obtain lower unit bid prices for the rehabilitation work based on economy of scale. RERC-JM implementation appears preferable if RERC plans to continue to administer the BCUA billings to the member municipalities, and if charges are not based on each participant's metered flow.

Advantages of Municipal Implementation. An advantage of municipal implementation is that responsibility for operating and maintaining the system rests with the municipality. One-shot rehabilitation by the RERC-JM would have to be closely coordinated with the municipalities. The cost of this coordination and the duplication of effort in RERC-JM transferring its data and recommendations for follow-up rehabilitation could be avoided by municipal implementation. Although the municipally implemented improvements may be subject to New Jersey Cap laws, exemptions may be gained from the State if the annual payments are less than 1.5 percent of the municipal capped budget. Exemptions may also be gained by municipal referendum. Additionally, municipal implementation may be preferable if each municipality is to be billed on the basis of its own metered flow.

Scheduling and Grant Assistance. In determining whether to await possible USEPA grant assistance for the repairs, grant availability and the percentage of project cost which may be funded requires consideration. Current USEPA grant availability is determined by a project priority list established by the NJDEP. Based on the continuation of the level of annual current Federal funds allocated to the State and the present ranking of the project of sewer rehabilitation in the RERC-JM, funds may be available in the mid-1990s. However, the grant eligible portion of the project may be small. Based on the presently proposed regulations, only 55 percent of the eligible construction cost, which is about 35 percent of the project cost, may be grant reimbursable. It does not appear cost-effective for the RERC-JM or its municipalities to delay implementation about ten years to obtain $140,000 in grant funds, thereby foregoing a potential BCUA user charge reduction of $50,000 per year during that period by implementing the I/I reduction program without delay.

Furthermore, the net savings from a Federal grant would be significantly less than $140,000 when the costs of the paperwork involved to obtain and administer the grant and its conditions, plus the probable increase in construction cost due to Federal Construction Regulations are deducted.

BCUA Requirements. As indicated in Section VIII, all of the recommended phases may not be cost effective for the RERC-JM or its municipalities to implement in terms of reduced BCUA user charges. However, it is recommended that the BCUA request that these repairs be implemented based on BCUA regulations. The BCUA regulations prohibit the "...discharge directly or indirectly into the local sewer system or Authority Treatment Works, any wastes or wastewater which cause, threaten to cause or are capable of causing either alone or by interaction with other substances--the Authority Treatment Works to be overloaded or cause excessive Authority collection or treatment costs." Excessive peak flows from inflow sources defined in Tables 3b, 4a and b, 4d, 5a and b, may overload the BCUA system, necessitating major BCUA costs for additional capacity. A contracting municipality or sewerage agency should therefore attempt to eliminate all sources of overall excessive inflow which were detected in the system for which it serves as the contracting agent.

Eliminating Inflow Sources on Private Property. Inflow sources on private property include roof, yard, driveway, parking lot and basement drains. Generally, these connections contravene municipal sewer ordinances. Diversion of these sources should be implemented by the property owner. It is recommended that the municipalities or the RERC-JM inform the property owners of the I/I sources which should be diverted. The BCUA may request status reports from time to time from each municipality or the RERC-JM regarding the status of the diversions summarized in Table 5.

Recommended Rehabilitation Program

Test-and-Seal Program. The recommended test-and-seal program includes each flow-isolated sewer reach unit with overall excessive unit infiltration rates and dyed-tested sewer reach with verified indirect inflow. The test-and-seal procedure involves four sequential tasks: cleaning and televising and the reach, pressure testing each joint and grouting each sewer joint which fails the test. Initially, the sewer is thoroughly cleaned to remove any deposits which could obscure the TV camera lens or impede the passage or effectiveness of the pressure test-grout packer. Winches are installed in the manholes to pull a television camera through the sewer to determine whether any structural flaw would prevent safe passage of the packer, and to detect any structural deficiency or visible leaks which the packer cannot rehabilitate. If the sewer appears sound, the packer is attached in front of the camera which aids the operator in positioning the packer on each sewer joint. The packer isolates and tests the watertightness of the sewer joint (or circumferential crack) by filling the isolated section with slightly pressurized air or water and then determining whether the pressure is maintained for a specified short time. The recommended test-and-seal procedure requires testing every joint in the reach because most of the joints which admit infiltration or indirect inflow during peak periods may not be visibly leaking at the time of televising. To insure against the possible entry of peak I/I, each joint which fails the pressure test, is immediately sealed with a quick setting grout introduced through the positioned packer and is retested before the packer is moved to the next joint. Any defect or leak which cannot be repaired by the grouting will be evaluated and reported to the municipality or the RERC-JM for possible future repair.

Based on a uniform unit infiltration rate per inch-mile of both sewer and building connections within reaches of older vitrified clay pipe, it is estimated the test-and-seal procedure will eliminate 82 percent of the I/I from the municipal sewer portion of the reach. The BCUA is conducting tests in 1984 to determine the accuracy of the 82 percent estimate. Tables 3a-A through 3a-U and Table 3b indicate the specific sewers recommended for inclusion in the test-and-seal contract(s) and the estimated I/I reductions which may be achieved. The costs in these tables are based on a previous estimate of $4715 per inch-mile. The currently estimated cost of $3536 per inch is used in Tables 1b and IX-1.

Test-and-Seal Contract Documents. The 1979 Plan of Study for the SSE work included the preparation of draft contract documents for the test-and-seal contract. At that time, it was estimated that BCUA may implement the contract with Federal Grant Assistance. A typical test-and-seal contract was developed for BCUA use with Federal Grant Assistance (BCUA Contract 96) which was approved by NJDEP in March 1983.

It is now recommended that the implementor of this work may be either the RERC-JM or its municipalities and either implementor may have specific contract requirements differing substantially from BCUA requirements. Therefore, completed BCUA contract documents for the recommended RERC-JM test-and-seal program were not prepared. In lieu of completed contract documents, it is recommended a copy of Contract 96 be made accessible to the implementors of the contracts at the time when their identity has been decided. The Engineer for the implementor may include specific municipal or RERC-JM requirements, and may delete specific BCUA or Federal Grant assistance requirements. Specific contract quantities, sewer reach data and a Contract Drawing which may be included in the Contract Documents have been developed and are included in this Report as Tables 3c, d, e and f and Plate 3 of this Report.

Diverting Storm Inlets. Table 4a lists the storm inlets directly connected to the sanitary system detected during the inflow investigations. Table 4a also notes the approximate area drained, the estimated flows, a possible method of diverting inflow from each source, the 1981 cost of the diversion and the 1981 overall cost savings benefit resulting from eliminating the inflow. Directly connected inlets were noted by the letter "A" on Plate 2.

Valving Storm System Interconnections. Table 4b lists the sanitary storm cross-connections detected during the Evaluation.

These connections are noted by the letter "D" on Plate 2. Generally, cross-connections were installed as emergency overflows to prevent backup of sanitary sewage into basements; however, under reversed head conditions, the cross-connection can serve as a source of inflow from a surcharged storm sewer. Inflow from the storm sewer can be eliminated by installing a flap valve on the cross-connection pipe. Table 4b indicates the estimated inflow reductions and the 1981 cost of the recommended repairs.

Unless it is determined that the cross-connection should be completely eliminated, the municipality should apply to the NJDEP for a discharge permit for its emergency overflows. The municipality may then be requested by the NJDEP to develop a plan to eliminate the need for the overflow.

Leaky Manhole Repair. Severe and typical manhole leaks detected during the 1982 manhole inspection or during the progress of the flow isolation are noted on Table 4c and with the letters "J" and "L" on Plate 2. A grout repair at a 1981 estimated cost of $200 per leak will generally eliminate the leakage. The estimated flow reductions resulting from the repairs are indicted in Table 4c. Due to the minor cost of this work, the municipalities may schedule these repairs as part of their standard sewer system maintenance procedures.

Floodprone Manhole Cover Replacement. The perforated manhole covers in floodprone locations and the inflow which may be admitted through each, are listed in Table 4d. The locations are also indicated by the letter "G" on Plate 2. The inflow from these covers may be nearly eliminated by the installation of new, gasketed, non-perforated manhole covers, measured to fit in the existing frame. To provide a continuous solid bearing surface for the gasket, fitted pieces of sheet metal may need to be affixed to the circumferential seat of the frame. The 1981 estimated cost of a typical installation was about $200. A BCUA Contract to replace about 1000 covers throughout the BCUA Service Area confirmed this unit cost. This cost does not include any minor road regrading to prevent temporary ponding over the manhole cover or any additional system venting which the municipality may deem necessary to compensate for the loss of ventilation through the manhole cover perforations.

Disconnecting Roof and Yard Drains on Private Property. Tables 5a and b list the roof and surface drains detected during the smoke testing phase of the Inflow Investigations. The tables also quantify the areas drained, the estimated flows, the overall 1981 benefit of eliminated the flows from the sanitary system and the 1981 cost, as well as a possible least-cost method of diverting the flows. Table 5 summarizes these tables. The locations of the roof and surface drains on private property are respectively indicated by the letters "B" and "C" on Plate 2.

SECTION X

CONTINUING EVALUATION AND REHABILITATION

Need. Implementation of the rehabilitation program recommended in this Report may reduce the I/I by about 30 percent. Accordingly, about 70 percent of the I/I may remain. Although USEPA allows for no future increase, I/I recent evaluation studies have indicated that about 1.0 to 1.5 percent of the remaining watertight joints in sewers constructed before 1930 may become porous each year due in part to natural deterioration of the organic joint material. It is possible that without a continuing evaluation and rehabilitation program, the increasing I/I resulting from this deterioration may offset any I/I reductions projected in this Report within 20 to 30 years.

Current USEPA policy also stresses that sewer system evaluation and rehabilitation should not be considered a "one shot" program but should be continued by the municipalities on a regularly scheduled basis, as part of operations and maintenance. The work may be performed by either the DPW staff or by municipal consultants. The following evaluation phases, which may locate additional I/I which is cost effective to eliminate, may be part of a continuing evaluation.

Buried Manhole Detection. As indicated on Plate 2, about ten percent of the manholes in the sewer system were either not located or were inaccessible during the manhole inspection phase of the SSE. The municipalities are advised to attempt to locate these manholes and excavate the covers of the buried or paved-over manholes. This will allow the manholes to serve their primary function of providing access to the sanitary system. These manholes may be opened and inspected for signs of leakage or inflow connections.

<u>High Groundwater Manhole Inspection</u>. At the time of the manhole inspection, the groundwater level was not always at its highest level. Additional manhole leaks may have been detected had the manhole been inspected during such periods which occur on average only a few days each year. The municipalities may schedule a DPW crew to inspect the manholes from above ground at times when the groundwater is very high, generally in the late winter or early spring after extensive periods of rainfall. This procedure may be repeated at ten-year intervals to detect new leaks which develop from traffic impacts and freeze-thaw cycles.

<u>Manhole Chimney Testing</u>. In recent years, defective masonry in the manhole chimney directly under the frame has been identified as a prime source of inflow peaks. However, this flow may only occur during and directly after rainfall, when drainage is percolating through the uppermost layers of the soil. Flooding the street cracks adjacent to a manhole with dyed water during high groundwater periods while observing the chimney for the seepage of dyed water may simulate this condition and allow detection of defective chimneys. Reconstruction of the chimney is a permanent method of stopping this inflow. Installation of hard, flexible rubber rings, attached with adjustable metal bands to the internal circumference of the chimney, may be a less expensive, temporary method of reducing the infiltration which does not require street excavation.

<u>Basement Drain Search</u>. A thorough inspection of the basement of all the 5000 Service Area buildings may disclose the drains which may admit up to 20 percent of the peak I/I which enters the system. However, achieving the permanent disconnection of all but a fraction of these drains may be difficult. The inspector may meet resistance in gaining access to a number of buildings, especially those with illicit drains. Also because of the rolling topography and generally moderate sewer slopes, infiltration seep-

ing into most basements which are not watertight may be drained to the sanitary system by gravity, by temporarily opening the sealed cleanout in the basement floor. Expecting residents to permanently seal these cleanouts and purchase and install sump pumps which discharge away from the building may be unrealistic. For this reason, a building to building search is not highly recommended.

Television Inspection. Internal televising of sewers has long been recognized as an effective investigative technique which may locate sewer defects and specific sources of I/I. However, due to the cost of preliminary cleaning and winch installation, televising has not always been a part of the normal operating and maintenance schedule.

During the past few years, there have been significant advances in the art of sewer system televising. A remote-controlled, self-propelled television camera is now available for rental, which allows rapid televising of a sewer without requiring preliminary cleaning, winches in manholes, electric generators or descent into manholes. With this "Ferret," a two-man crew may easily televise a mile of sewer or more per day, cataloging visible system defects and the location of building connections. Trunks, subtrunks and interceptor sewers may be televised at night when the flows are low. The current rental rate for the Ferret equipment is about $1000 per week. Using this equipment, each municipality may inexpensively televise its tributary sewers which are not included in the test and seal program, in less than a month. It is recommended that the municipalities televise their systems at ten-year intervals thereafter.

Repair of Detected Defects. The television inspection may detect several sewer defects which may be costly to repair. If these defects are not a present hazard, the municipality may wish to defer repair until it is clear whether meaningful grant assistance, either from I/I reduction programs or infrastructure repair programs, may become available. Based on the current NJDEP priority list and USEPA funding levels, it may be at least ten years before any USEPA funding may be available.

Updating the I/I Analysis. Ten years after the proposed BCUA meters are installed, it is recommended that engineers or consultants for the municipalities be authorized to obtain copies of the meter charts to that date and to update the I/I Analysis. Based on a reevaluation of the normalized average infiltration rates, the peak flow rates, the updated costs of sewer evaluation and repair, and the updated cost savings resulting from repair, the engineer may determine that additional sewer system evaluation steps may be cost effective.

Long-Term Rehabilitation.

Sewer Life Span. The estimated useful life span of sanitary sewers constructed prior to 1950 is from 50 to 100 years. Most of the sewers in the RERC-JM system with the exception of the interceptors, are about 80 years old. It is likely that an increasing number of structural collapses will be occurring as more and more sewers reach the end of the useful life span.

Costs. The current cost of completely replacing all the gravity sewers in the RERC-JM Service Area, including the building connections, may be about $21 million. This cost includes about $2 million for RERC-JM sewers, $5 million in the Carlstadt system, $5 million in the East Rutherford system and $9 million in the Rutherford system. In the absence of Federal assistance for infrastructure repair or replacement, the Boroughs and RERC-JM may be facing a large expenditure over the coming decades. The municipalities are advised to consider the cost of replacing most of their aging system over a period of several decades, when developing their long-term budget needs.

<u>Priority</u>. Based on the results of the flow isolation and defects noted during recommended televising, the replacement of each sewer reach may be assigned a priority ranking. A certain number of the sewers may be replaced or possibly lined each year in order of the replacement ranking.

<u>Building Connections</u>. When the sewers are replaced, the building connection sewers attached should be replaced or relined at the same time. Deteriorating building connections have been identified as a prime source of excessive infiltration. Special implementation arrangements may be required to allow the municipalities to rehabilitate the building sewers which are on private property.

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TABLES

TABLE 1

RERC JOINT MEETING

SUMMARY OF PRESENT AND PROJECTED SANITARY SEWAGE FLOWS (1)

	Average Flow (mgd)			Peak Flow (mgd)		
	Present (2)	Projected Change (3)	Design (4)	Present (5)	Projected Change (6)	Design (4)
Residential						
C	0.53	0.04	0.57	0.80	0.06	0.86
E	0.43	0.02	0.45	0.64	0.03	0.67
R	0.63	0.00	0.63	0.94	0.00	0.94
Subtotal	1.59	0.06	1.65	2.38	0.09	2.47
Employee-Commercial						
C	0.18	0.04	0.22	0.54	0.12	0.66
E	0.09	0.01	0.10	0.27	0.03	0.30
R	0.09	0.04	0.13	0.27	0.12	0.27
Subtotal	0.36	0.09	0.45	1.08	0.27	1.23
Industrial						
C (7)	0.38	0.05	0.43	1.14	0.15	1.29
E	0.22	0.02	0.34	0.66	0.06	0.72
R	0.01	0.01	0.02	0.03	0.03	0.06
Subtotal (7)	0.61	0.08	0.79	1.83	0.24	2.07
Total Base						
C	1.09	0.13	1.22	2.48	0.33	2.81
E	0.74	0.05	0.79	1.57	0.12	1.63
R	0.73	0.05	0.78	1.24	0.15	1.39
Subtotal	2.56	0.23	2.79	5.29	0.60	5.89
Infiltration						
C	0.26	-0.10	0.16	2.61	-1.02	1.59
E	0.17	-0.04	0.13	1.66	-0.40	1.26
R	0.37	-0.10	0.27	3.74	-1.04	2.70
Subtotal (8)	0.80	-0.24	0.56	8.01	-2.46	5.55
Inflow						
C (7)	0.02	-negl	0.02	1.20	-0.48	0.72
E (7)	0.02	-negl	0.02	1.20	-0.17	1.03
R	0.02	-0.01	0.01	1.20	-0.60	0.60
Subtotal (7)	0.06	-0.01	0.05	3.60	-1.25	2.35
Total I/I						
C	0.28	-0.10	0.08	3.81	-1.50	2.31
E	0.19	-0.04	0.15	2.86	-0.57	2.29
R	0.39	-0.11	0.28	4.94	-1.64	3.30
Subtotal	0.86	-0.25	0.51	11.61	-3.71	7.90
Total Flow						
C	1.37	0.03	1.40	6.29	-1.17	5.12
E	0.93	0.01	0.94	4.43	-.45	3.98
R	1.12	-0.06	1.06	6.18	-1.49	4.69
TOTAL	3.42	-0.02	3.40	16.90	-3.11	13.79

Notes:

(1) From present service area, excluding flows from Lyndhurst, North Arlington and portions of RERC-JM municipalities east of Berry's Creek.

(2) Based on totals indicated in BCUA 1981 I/I Analysis and SSE Report, revised as noted in Section IV.

(3) Based on base flow increases in 1981 I/I Analysis and SSE Report unless otherwise noted and overall cost-effective I/I reductions indicated in this SSE Report.

(4) Based on year 2000; however, because of flat growth projection, these flows may be applicable to later dates.

(5) Based on 1.5 x avg residential flow; 3 x avg employee-commercial and industrial flow; 10 x avg infiltration and 60 x avg inflow.

(6) Change in peak inflow based on sum of potential peak inflow reductions summarized in Table 1a rather than on typical multiplier of 60 x avg infiltration reduction.

(7) Previous present flow estimate adjusted upward to compensate for 1984 re-estimate of average infiltration.

(8) Previous present infiltration estimate adjusted downward based on 1984 estimates. For redistribution by minisystem, see Table 2.

CARLSTADT MINISYSTEM B

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
Reach	Street	Upper/Lower Manhole	Lateral + Trunk Length (ft)	Lateral + Trunk Diameter (in)	Building Connections Number	Building Connections Length(ft)	DiameterxLength <La> (1) (in-mi)	DiameterxLength <Lt> (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/Cost Ratio
	SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																								
51	THIRTEENTH ST N OF BROAD ST	397/130	775	8	4	300	1.17	1.40	04/19/82	137.00	112.5	24.50	1.25	19.60	117.60	83.91	196.0	68.7	13.47	80.79	134.7	94.5	5.5	89.0	17.07
8	S SIDE BROAD ST W OF SIXTEENTH	163/160	450	8	2	60	0.68	0.73	04/19/82	4.70	0.06	4.64	1.25	3.71	22.27	30.62	37.1	76.9	2.85	17.12	28.5	20.0	3.2	16.8	6.23
5	N SIDE BROAD ST W OF FIFTEENTH	151/140	272	8	2	70	0.41	0.47	04/19/82	2.50	0.06	2.44	1.25	1.95	11.71	25.18	19.5	72.7	1.42	8.51	14.2	10.0	1.9	8.0	5.12
2	BROAD ST E OF TWELFTH ST	140/110	498	18	6	170	1.70	1.83	04/19/82	9.00	0.18	8.82	1.25	7.06	42.34	23.18	70.6	76.2	5.38	32.27	53.8	37.8	8.0	29.7	4.72
6	FOURTEENTH ST S OF BROAD ST	161/150	310	8	2	70	0.47	0.52	04/19/82	2.50	0.06	2.44	1.25	1.95	11.71	22.41	19.5	73.7	1.44	8.63	14.4	10.1	2.2	7.9	4.56
47	N SIDE BROAD ST AT ROUTE 17	400/142	250	12	1	25	0.57	0.59	04/19/82	1.14	0.03	1.11	1.25	0.89	5.33	9.07	8.9	79.4	0.70	4.23	7.0	4.9	2.7	2.3	1.85
87	EIGHTH ST N OF PASSAIC AVE	434/433	233	8	8	240	0.35	0.53	04/19/82	1.14	0.24	0.90	1.25	0.72	4.32	8.08	7.2	54.1	0.39	2.34	3.9	2.7	1.7	1.1	1.64
	7 SUBTOTAL IN CONTRACT		2788		25	935	5.35	(.07		157.98	113.13	44.85		35.88	215.28	35.47	358.8	71.5	25.65	153.89	256.5	180.0	25.2	154.8	7.14
	SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																								
38	BROAD ST W OF EIGHTH ST	330/320	251	8	2	56	0.38	0.42	04/16/82	0.67	0.06	0.61	1.18	0.52	3.10	7.34	5.2	73.8	0.38	2.29	3.8	2.7	1.8	0.9	1.49
13	BROAD ST W OF TWELFTH ST	170/110	225	18	0	0	0.77	0.77	04/19/82	1.14	0.00	1.14	1.25	0.91	5.47	7.13	9.1	82.0	0.75	4.49	7.5	5.2	3.6	1.6	1.45
84	EIGHTH ST N OF MARSAN DR	464/462	170	8	5	150	0.26	0.37	04/19/82	0.67	0.15	0.52	1.25	0.42	2.50	6.72	4.2	56.9	0.24	1.42	2.4	1.7	1.2	0.4	1.37
59	DIVISION ST W OF ROUTE 17	405/403	245	8	4	100	0.37	0.45	04/19/82	0.67	0.12	0.55	1.25	0.44	2.64	5.91	4.4	68.1	0.30	1.80	3.0	2.1	1.8	0.4	1.20
50	N SIDE BROAD ST W OF FOURTEENT	392/140	328	8	4	92	0.50	0.57	04/19/82	0.67	0.12	0.55	1.25	0.44	2.64	4.66	4.4	71.9	0.32	1.90	3.2	2.2	2.3	-0.1	0.95
64	N SIDE BROAD ST W OF ROUTE 17	420/400	480	8	9	265	0.73	0.93	04/19/82	1.14	0.27	0.87	1.25	0.70	4.18	4.50	7.0	64.3	0.45	2.68	4.5	3.1	3.4	-0.3	0.92
72	BERRY AVE W OF NINETH ST	324/409	250	8	0	0	0.38	0.38	04/19/82	0.35	0.00	0.35	1.25	0.28	1.68	4.44	2.8	82.0	0.23	1.38	2.3	1.6	1.8	-0.2	0.90
71	BERRY AVE W OF TENTH ST	409/407	230	8	0	0	0.35	0.35	04/19/82	0.32	0.00	0.32	1.25	0.26	1.54	4.41	2.6	82.0	0.21	1.26	2.1	1.5	1.6	-0.2	0.90
1	TWELFTH ST S OF BROAD ST	110/100	300	24	3	105	1.36	1.44	04/19/82	1.36	0.09	1.27	1.25	1.02	6.10	4.22	10.2	77.5	0.79	4.72	7.9	5.5	6.4	-0.9	0.86
54	TWELFTH ST N OF BROAD ST	396/392	308	8	0	0	0.47	0.47	04/19/82	0.35	0.00	0.35	1.25	0.28	1.68	3.60	2.8	82.0	0.23	1.38	2.3	1.6	2.2	-0.6	0.73
73	NINETH ST N OF BERRY AVE	STUB/432	305	8	7	210	0.46	0.62	04/19/82	0.67	0.21	0.46	1.25	0.37	2.21	3.55	3.7	61.0	0.22	1.35	2.2	1.6	2.2	-0.6	0.72

Continued on **Sheet 2 of 3**

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

CARLSTADT MINISYSTEM B

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS				NORMALIZED INFILTRATION						POSSIBLE INFILTRATION REDUCTION			COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		DiameterxLength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																									
19	ROUTE 17 W OF BERRY AVE	260/220	580	12	4	120	1.32	1.41	04/19/82	1.14	0.12	1.02	1.25	0.82	4.90	3.47	8.2	76.7	0.63	3.76	6.3	4.4	6.2	-1.8	0.71
81	NINETH ST N OF MARSAN DR	461/460	160	8	4	100	0.24	0.32	04/19/82	0.35	0.12	0.23	1.25	0.18	1.10	3.47	1.8	62.5	0.11	0.69	1.1	0.8	1.1	-0.3	0.71
23	RT17 N OF PASSAIC ROW TO EIGHT	460/260	1413	12	4	154	3.21	3.33	04/19/82	2.50	0.12	2.38	1.25	1.90	11.42	3.43	19.0	79.1	1.51	9.04	15.1	10.6	15.1	-4.6	0.70
28	S SIDE BROAD ST W OF ROUTE 17	300/170	600	10	9	225	1.14	1.31	04/16/82	1.14	0.27	0.87	1.18	0.74	4.42	3.39	7.4	71.3	0.53	3.15	5.3	3.7	5.4	-1.7	0.69
57	ROUTE 17 N OF BROAD ST	403/400	560	8	3	180	0.85	0.98	04/19/82	0.67	0.09	0.58	1.25	0.46	2.78	2.83	4.6	70.6	0.33	1.97	3.3	2.3	4.0	-1.7	0.58
40	SEVENTH ST W OF DIVISION ST	350/340	540	8	6	168	0.82	0.95	04/16/82	0.67	0.18	0.49	1.18	0.42	2.49	2.64	4.2	71.0	0.29	1.77	2.9	2.1	3.9	-1.8	0.54
45	CENTER ST W OF SEVENTH ST	381/380	200	8	5	125	0.30	0.40	04/16/82	0.35	0.15	0.20	1.18	0.17	1.02	2.56	1.7	62.5	0.11	0.64	1.1	0.7	1.4	-0.7	0.52
14	ROUTE 17 N OF BROAD ST	200/170	490	12	3	150	1.11	1.23	04/19/82	0.67	0.09	0.58	1.25	0.46	2.78	2.27	4.6	74.4	0.35	2.07	3.5	2.4	5.3	-2.8	0.46
85	EIGHTH ST AT MARSAN DR	463/462	155	8	6	180	0.23	0.37	04/19/82	0.35	0.18	0.17	1.25	0.14	0.82	2.20	1.4	51.9	0.07	0.42	0.7	0.5	1.1	-0.6	0.45
36	EIGHTH ST N OF DIVISION ST	324/323	540	8	8	0	0.82	0.82	04/16/82	0.49	0.24	0.25	1.18	0.21	1.27	1.55	2.1	82.0	0.17	1.04	1.7	1.2	3.9	-2.6	0.32
86	PASSAIC AVE W OF NINETH ST	433/430	268	8	6	180	0.41	0.54	04/19/82	0.35	0.18	0.17	1.25	0.14	0.82	1.50	1.4	61.4	0.08	0.50	0.8	0.6	1.9	-1.3	0.31
88	EIGHTH ST N OF PASSAIC AVE	325/433	325	8	14	420	0.49	0.81	04/19/82	0.67	0.42	0.25	1.25	0.20	1.20	1.48	2.0	49.8	0.10	0.60	1.0	0.7	2.3	-1.6	0.30
74	NINETH ST N OF PASSAIC AVE	432/430	344	8	9	265	0.52	0.72	04/19/82	0.47	0.27	0.20	1.25	0.16	0.96	1.33	1.6	59.2	0.09	0.57	0.9	0.7	2.5	-1.8	0.27
17	ROUTE 17 N OF DIVISION ST	220/200	530	12	2	100	1.20	1.28	04/19/82	0.35	0.06	0.29	1.25	0.23	1.39	1.09	2.3	77.1	0.18	1.07	1.8	1.3	5.7	-4.4	0.22
67	NINETH ST N OF BROAD ST	422/420	545	8	16	400	0.83	1.13	04/19/82	0.67	0.48	0.19	1.25	0.15	0.91	0.81	1.5	60.0	0.09	0.55	0.9	0.6	3.9	-3.3	0.16
34	EIGHTH ST N OF BROAD ST	323/320	540	8	17	510	0.82	1.20	04/16/82	0.65	0.51	0.14	1.18	0.12	0.71	0.59	1.2	55.7	0.07	0.40	0.7	0.5	3.9	-3.4	0.12
61	TENTH ST W OF DIVISION ST	407/405	530	8	17	425	0.80	1.13	04/19/82	0.67	0.57	0.10	1.25	0.08	0.48	0.43	0.8	53.5	0.05	0.28	0.5	0.3	3.8	-3.5	0.09
83	MARSAN DR W OF NINETH ST	462/460	223	8	4	120	0.34	0.43	04/19/82	0.14	0.12	0.02	1.25	0.02	0.10	0.22	0.2	64.6	0.01	0.06	0.1	0.1	1.6	-1.5	0.05
70	NINETH ST N OF BROAD ST	424/420	600	8	14	350	0.91	1.17	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.4	-1.4	0.00
63	TENTH ST N OF DIVISION ST	412/405	507	8	14	350	0.77	1.03	04/19/82	0.35	0.35	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	3.6	-3.6	0.00
55	ROUTE 17 S OF BROAD ST	402/400	600	8	4	270	0.91	1.11	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.3	-4.3	0.00

Continued on Sheet 3 of 3

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

CARLSTADT MI[illegible]

FLOW ISOLATION SUMMARY AND TE[illegible] AL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		DiameterxLength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																
58	ROUTE 17 W OF DIVISION ST	404/403	200	8	0	0	0.30	0.30	04/16/82	0.35	0.35	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.8	-4.8	0.00
60	DIVISION ST W OF TENTH ST	406/405	115	8	2	50	0.17	0.21	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	0.8	-0.8	0.00
69	NINETH ST N OF DIVISION ST	423/422	509	8	10	250	0.77	0.96	04/19/82	0.15	0.15	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.3	-4.3	0.00
62	TENTH ST N OF BERRY AVE	408/407	100	8	4	100	0.15	0.23	04/16/82	0.14	0.14	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.5	-1.5	0.00
43	SEVENTH ST N OF PASSAIC AVE	380/360	588	8	18	84	0.89	0.95	04/16/82	0.47	0.47	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	3.9	-3.9	0.00
39	SEVENTH ST N OF BROAD ST	340/330	540	8	17	476	0.82	1.18	04/16/82	0.53	0.53	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.2	-4.2	0.00
42	PASSAIC AVE W OF SEVENTH ST	361/360	216	8	14	0	0.33	0.33	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	0.7	-0.7	0.00
10	SIXTEENTH ST S OF BROAD ST	165/163	400	8	0	0	0.61	0.61	04/19/82	0.67	0.67	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	3.3	-3.3	0.00
37	EIGHTH ST N OF BERRY AVE	325/324	350	8	15	450	0.53	0.87	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	3.7	-3.7	0.00
65	TENTH ST N OF BROAD ST	411/410	600	8	13	390	0.91	1.20	04/16/82	0.35	0.35	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	2.2	-2.2	0.00
46	SEVENTH ST N OF CENTER ST	382/380	166	8	8	240	0.25	0.43	04/19/82	0.35	0.35	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	5.9	-5.9	0.00
90	ROW E OF RT 17 W OF TWELFTH ST	B100/H350	200	24	0	0	0.91	0.91	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.3	-4.3	0.00
33	EIGHTH ST S OF BROAD ST	321/320	600	8	23	575	0.91	1.34	04/16/82	0.14	0.14	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.2	-1.2	0.00
77	NINETH ST N OF PASSAIC AVE	460/430	465	8	27	705	0.70	1.24	04/16/82	0.35	0.35	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.3	-4.3	0.00
82	SEVENTH ST S OF BROAD ST	C100/330	665	10	22	660	1.26	1.76	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	3.6	-3.6	0.00
91	BROAD ST W OF SIXTEENTH ST	A100/151	230	18	2	70	0.78	0.84	04/19/82	0.15	0.15	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.3	-4.3	0.00
31	BROAD ST W OF NINETH ST	320/300	245	10	13	355	0.46	0.73	04/16/82	0.00	0.00	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	2.5	-2.5	0.00
89	BROAD ST W OF SEVENTH ST	D100/330	236	8	8	400	0.36	0.66	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.7	-1.7	0.00
41	SEVENTH ST N OF BERRY AVE	360/350	675	8	26	780	1.02	1.61	04/19/82	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	2.9	-2.9	0.00
	51 SUBTOTAL NOT IN CONTRACT		20442		425	11355	36.20	[illegible]		24.31	9.19	15.12		12.24	73.31	1.64	122.4	72.6	8.89	53.25	88.9	62.3	170.7	108.4	0.36
	TOTAL		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		182.29	122.32	59.97		48.12	288.59	5.87	481.2	71.8	34.54	207.14	345.4	242.3	195.9	46.4	[illegible]

FOOTNOTES FOR KERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

CARLSTADT MINISYSTEM D

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameterxlength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																
1	SIXTH ST AT BROAD ST	130/100	105	8	0	0	0.16	0.16	04/14/82	0.67	0.00	0.67	1.33	0.50	3.02	19.00	5.0	82.0	0.41	2.48	4.1	2.9	0.8	2.1	3.87
10	DIVISION ST W OF FIFTH ST	153/152	162	8	1	60	0.25	0.29	04/14/82	1.14	0.03	1.11	1.33	0.83	5.01	17.21	8.3	69.2	0.58	3.46	5.8	4.1	1.2	2.9	3.50
11	FIFTH ST N OF DIVISION ST	154/152	264	8	1	60	0.40	0.45	04/14/82	1.14	0.03	1.11	1.33	0.83	5.01	11.24	8.3	73.6	0.61	3.69	6.1	4.3	1.9	2.4	2.29
31A	SUMMIT AVE E OF THIRD ST	STUB/185	175	8	4	200	0.27	0.42	04/14/82	1.14	0.12	1.02	1.33	0.77	4.60	11.04	7.7	52.2	0.40	2.40	4.0	2.8	1.3	1.6	2.25
23	FOURTH ST N OF BROAD ST	171/170	298	8	19	1140	0.45	1.32	04/15/82	3.50	0.57	2.93	1.24	2.36	14.18	10.78	23.6	28.2	0.67	3.99	6.7	4.7	2.1	2.5	2.19
31	THIRD ST N OF SUMMIT AVE	186/185	291	8	7	350	0.44	0.71	04/14/82	1.70	0.21	1.49	1.33	1.12	6.72	9.52	11.2	51.2	0.57	3.44	5.7	4.0	2.1	1.9	1.94
76	HILL ST S OF CENTER ST	297/295	435	8	11	495	0.66	1.03	04/14/82	2.50	0.33	2.17	1.33	1.63	9.79	9.47	16.3	52.3	0.85	5.12	8.5	6.0	3.1	2.9	1.93
44	CENTRAL AVE E OF FIRST ST	231/230	191	8	6	270	0.29	0.49	04/15/82	1.14	0.18	0.96	1.24	0.77	4.65	9.40	7.7	48.0	0.37	2.23	3.7	2.6	1.4	1.2	1.91
18	CENTRAL AVE W OF HACKENSACK AV	165/164	379	8	7	350	0.57	0.84	04/15/82	1.70	0.21	1.49	1.24	1.20	7.21	8.59	12.0	56.1	0.67	4.04	6.7	4.7	2.7	2.0	1.75
49	FIRST ST N OF SUMMIT AVE	236/234	225	8	7	280	0.34	0.55	04/16/82	1.14	0.21	0.93	1.18	0.79	4.73	8.55	7.9	50.5	0.40	2.39	4.0	2.8	1.6	1.2	1.74
42	DIVISION ST W OF FIRST ST	221/220	270	8	6	240	0.41	0.59	04/15/82	1.14	0.18	0.96	1.24	0.77	4.65	7.86	7.7	56.8	0.44	2.64	4.4	3.1	1.9	1.2	1.60
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	11 SUBTOTAL IN CONTRACT		2795		69	3445	4.24	6.85		16.91	2.07	14.84		11.57	69.57	10.16	115.7	51.6	5.97	35.88	59.7	42.0	20.1	21.9	2.09
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																
56	MONROE ST N OF SUMMIT AVE	255/254	283	8	7	280	0.43	0.64	04/16/82	1.14	0.21	0.93	1.18	0.79	4.73	7.38	7.9	54.9	0.43	2.59	4.3	3.0	2.0	1.0	1.50
69	CENTER ST W OF SIXTH ST	301/300	191	8	7	420	0.29	0.61	04/14/82	1.14	0.21	0.93	1.33	0.70	4.20	6.91	7.0	39.1	0.27	1.64	2.7	1.9	1.4	0.6	1.41
29	CENTRAL AVE W OF THIRD ST	184/183	199	8	8	400	0.30	0.60	04/14/82	1.14	0.24	0.90	1.33	0.68	4.06	6.72	6.8	40.9	0.28	1.66	2.8	1.9	1.4	0.5	1.37
71	FIFTH ST S OF PASSAIC AVE	293/291	656	8	11	655	0.99	1.49	04/14/82	2.50	0.33	2.17	1.33	1.63	9.79	6.57	16.3	54.7	0.89	5.35	8.9	6.3	4.7	1.6	1.34
6	BROAD ST W OF LILAC LN	160/130	399	8	3	210	0.60	0.76	04/14/82	1.14	0.09	1.05	1.33	0.79	4.74	6.20	7.9	64.9	0.51	3.08	5.1	3.6	2.9	0.7	1.26
13	HACKENSACK ST N OF BROAD ST	162/160	608	8	33	1980	0.92	2.42	04/15/82	4.03	0.99	3.04	1.24	2.45	14.71	6.08	24.5	31.2	0.76	4.59	7.6	5.4	4.3	1.0	1.24
38	SECOND ST N OF SUMMIT AVE	196/194	277	8	8	400	0.42	0.72	04/15/82	1.14	0.24	0.90	1.24	0.73	4.35	6.03	7.3	47.6	0.35	2.07	3.5	2.4	2.0	0.4	1.23

Continued on Sheet 2 of 3

FOOTNOTES FOR [illegible] JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

CARLSTADT MINISYSTEM D

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameterxlength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																									
59	MADISON ST N OF SUMMIT AVE	258/257	292	8	10	500	0.44	0.82	04/16/82	1.14	0.30	0.84	1.18	0.71	4.27	5.20	7.1	44.2	0.31	1.89	3.1	2.2	2.1	0.1	1.06
75	CENTER ST W OF FIFTH ST	295/294	239	8	8	400	0.36	0.67	04/14/82	1.00	0.24	0.76	1.33	0.57	3.43	5.15	5.7	44.6	0.26	1.53	2.6	1.8	1.7	0.1	1.05
61	SIXTH ST AT BROAD ST	263/260	545	8	11	550	0.83	1.24	04/14/82	1.70	0.33	1.37	1.33	1.03	6.18	4.97	10.3	54.5	0.56	3.37	5.6	3.9	3.9	0.0	1.01
47	FIRST ST S OF SUMMIT AVE	234/233	301	8	11	495	0.46	0.83	04/16/82	1.14	0.33	0.81	1.18	0.69	4.12	4.96	6.9	45.0	0.31	1.85	3.1	2.2	2.2	0.0	1.01
21	HACKENSACK ST N OF SUMMIT AVE	168/167	246	8	4	240	0.37	0.55	04/15/82	0.67	0.12	0.55	1.24	0.44	2.66	4.80	4.4	55.1	0.24	1.47	2.4	1.7	1.8	0.0	0.98
4	LILAC LN S OF BROAD ST	132/130	510	8	5	325	0.77	1.02	04/14/82	1.14	0.15	0.99	1.33	0.74	4.47	4.38	7.4	62.2	0.46	2.78	4.6	3.2	3.6	-0.4	0.89
57	SUMMIT AVE E OF MONROE ST	256/254	203	8	7	315	0.31	0.55	04/16/82	0.67	0.21	0.46	1.18	0.39	2.34	4.28	3.9	46.2	0.18	1.08	1.8	1.3	1.5	-0.2	0.87
22	BROAD ST W OF HACKENSACK ST	170/160	276	8	5	250	0.42	0.61	04/15/82	0.67	0.15	0.52	1.24	0.42	2.52	4.14	4.2	56.4	0.24	1.42	2.4	1.7	2.0	-0.3	0.84
48	SUMMIT AVE E OF FIRST ST	235/234	225	8	7	315	0.34	0.58	04/16/82	0.67	0.21	0.46	1.18	0.39	2.34	4.04	3.9	48.2	0.19	1.13	1.9	1.3	1.6	-0.3	0.82
16	DIVISION ST W OF HACKENSACK ST	163/162	392	8	11	495	0.59	0.97	04/15/82	1.14	0.33	0.81	1.24	0.65	3.92	4.04	6.5	50.3	0.33	1.97	3.3	2.3	2.8	-0.5	0.82
37	SUMMIT AVE W OF THIRD ST	195/194	202	8	7	350	0.31	0.57	04/15/82	0.67	0.21	0.46	1.24	0.37	2.23	3.90	3.7	43.9	0.16	0.98	1.6	1.1	1.4	-0.3	0.79
19	HACKENSACK AVE N OF CENTRAL AV	167/164	598	8	17	1020	0.91	1.68	04/15/82	1.70	0.41	1.29	1.24	1.04	6.24	3.72	10.4	44.3	0.46	2.76	4.6	3.2	4.3	-1.0	0.76
45	CENTRAL AVE W OF FIRST ST	232/230	210	8	8	320	0.32	0.56	04/15/82	0.67	0.24	0.43	1.24	0.35	2.08	3.71	3.5	46.5	0.16	0.97	1.6	1.1	1.5	-0.4	0.76
55	MONROE ST S OF SUMMIT AVE	254/253	295	8	10	100	0.45	0.52	04/16/82	0.67	0.30	0.37	1.18	0.31	1.88	3.60	3.1	70.1	0.22	1.32	2.2	1.5	2.1	-0.6	0.73
25	BROAD ST AT THIRD ST	190/170	498	8	10	470	0.75	1.11	04/14/82	1.14	0.30	0.84	1.33	0.63	3.79	3.41	6.3	55.7	0.35	2.11	3.5	2.5	3.6	-1.1	0.69
39	BROAD ST AT FIRST ST	240/190	501	8	12	540	0.76	1.17	04/15/82	1.14	0.36	0.78	1.24	0.63	3.77	3.23	6.3	53.3	0.34	2.01	3.4	2.4	3.6	-1.2	0.66
67	SIXTH ST N OF PASSAIC AVE	300/290	585	8	13	650	0.89	1.38	04/14/82	1.36	0.39	0.97	1.33	0.73	4.38	3.17	7.3	52.7	0.38	2.31	3.8	2.7	4.2	-1.5	0.65
58	SUMMIT AVE W OF MONROE ST	257/254	254	8	7	280	0.38	0.60	04/16/82	0.56	0.21	0.35	1.18	0.30	1.78	2.98	3.0	52.9	0.16	0.94	1.6	1.1	1.8	-0.7	0.61
8	FIFTH ST N OF BROAD ST	152/150	631	8	13	780	0.96	1.55	04/14/82	1.36	0.39	0.97	1.33	0.73	4.38	2.83	7.3	50.7	0.37	2.22	3.7	2.6	4.5	-1.9	0.58
17	HACKENSACK ST N OF BROAD ST	164/162	311	8	8	480	0.47	0.83	04/15/82	0.67	0.24	0.43	1.24	0.35	2.08	2.49	3.5	46.3	0.16	0.96	1.6	1.1	2.2	-1.1	0.51
53	MONROE ST AT CENTRAL AVE	253/251	595	8	20	900	0.90	1.58	04/16/82	1.14	0.60	0.54	1.18	0.46	2.75	1.73	4.6	46.7	0.21	1.28	2.1	1.5	4.3	-2.8	0.35

Continued on Sheet 3 of 3

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

CARLSTADT MINISYSTEM F

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
Reach	Street	Upper/Lower Manhole	Lateral + Trunk Length (ft)	Lateral + Trunk Diameter (in)	Building Connections Number	Building Connections Length(ft)	Diameterxlength <Ls> (1) (in-mi)	Diameterxlength <Lt> (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/ Cost Ratio
	SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																								
5	PATERSON AVE AT GARDEN ST	140/120	110	8	0	0	0.17	0.17	04/14/82	3.50	0.00	3.50	1.33	2.63	15.79	94.74	26.3	82.0	2.16	12.95	21.6	15.1	0.8	14.4	19.28
19	BROAD ST AT ORCHARD ST	170/160	227	8	0	0	0.34	0.34	04/18/83	11.61	0.00	11.61	4.50	2.58	15.48	45.01	25.8	82.0	2.12	12.69	21.2	14.9	1.6	13.2	9.16
54	INDUSTRIAL AVE	903/901	367	8	3	175	0.56	0.69	04/15/83	11.61	0.09	11.52	2.60	4.43	26.58	38.60	44.3	66.2	2.93	17.60	29.3	20.6	2.6	18.0	7.86
15	GARDEN ST N OF HOBOKEN RD	160/140	580	8	2	70	0.88	0.93	04/14/82	7.60	0.06	7.54	1.33	5.67	34.02	36.50	56.7	77.3	4.38	26.30	43.8	30.8	4.1	26.6	7.43
56	INDUSTRIAL AVE N OF PUMP STN	906/903	611	8	3	220	0.93	1.09	04/15/83	13.85	0.09	13.76	2.60	5.29	31.75	29.07	52.9	69.5	3.68	22.07	36.8	25.8	4.4	21.5	5.91
6	PATERSON AVE AT HOBOKEN RD	125/120	625	8	0	0	0.95	0.95	04/14/82	4.70	0.00	4.70	1.33	3.53	21.20	22.39	35.3	82.0	2.90	17.39	29.0	20.3	4.5	15.9	4.56
51	INDUSTRIAL AVE N OF PUMP STN	901/898	455	8	3	175	0.69	0.82	04/15/83	7.66	0.09	7.57	2.60	2.91	17.47	21.25	29.1	68.8	2.00	12.01	20.0	14.1	3.3	10.8	4.32
31	ORCHARD ST N OF BROAD ST	171/170	333	6	1	30	0.38	0.40	04/18/83	6.10	0.03	6.07	4.50	1.35	8.09	20.18	13.5	77.4	1.04	6.26	10.4	7.3	1.8	5.5	4.11
11	N SIDE HOBOKEN RD E OF PATERSN	141/140	365	8	0	0	0.55	0.55	04/14/82	2.40	0.00	2.40	1.33	1.80	10.83	19.58	18.0	82.0	1.48	8.88	14.8	10.4	2.6	7.8	3.98
4	PATERSON AVE W OF GARDEN ST	121/120	272	8	1	25	0.41	0.43	04/14/82	1.70	0.03	1.67	1.33	1.26	7.53	17.48	12.6	78.4	0.98	5.91	9.8	6.9	1.9	5.0	3.56
28	CENTRAL AVE N OF LINCOLN ST	213/210	229	8	9	360	0.35	0.62	04/18/83	7.66	0.27	7.39	4.50	1.64	9.85	15.90	16.4	45.9	0.75	4.52	7.5	5.3	1.6	3.7	3.24
59	INDUSTRIAL AVE N OF PUMP STN	909/906	549	8	3	220	0.83	1.00	04/15/83	6.10	0.09	6.01	2.60	2.31	13.87	13.89	23.1	68.3	1.58	9.47	15.8	11.1	3.9	7.2	2.83
2	POPLAR ST S OF PATERSON AVE	120/100	554	12	2	75	1.26	1.32	04/14/82	4.10	0.06	4.04	1.33	3.04	18.23	13.85	30.4	78.5	2.38	14.30	23.8	16.7	5.9	10.8	2.82
23	LINCOLN ST N OF BROAD ST	210/180	945	8	15	700	1.43	1.96	04/18/83	19.35	0.45	18.90	4.50	4.20	25.20	12.84	42.0	59.8	2.51	15.08	25.1	17.6	6.8	10.9	2.61
38	GARDEN ST S OF CARLYLE CT	280/250	664	8	12	355	1.01	1.28	04/15/82	3.50	0.36	3.14	1.24	2.53	15.19	11.92	25.3	64.7	1.64	9.83	16.4	11.5	4.7	6.8	2.42
18	GARDEN ST N OF BROAD ST	230/160	660	8	9	345	1.00	1.26	04/14/82	3.50	0.27	3.23	1.33	2.43	14.57	11.55	24.3	65.0	1.58	9.47	15.8	11.1	4.7	6.4	2.35
12	N SIDE HOBOKEN RD E OF PATERSN	142/141	225	8	5	375	0.34	0.63	04/14/82	1.70	0.15	1.55	1.33	1.17	6.99	11.19	11.7	44.7	0.52	3.13	5.2	3.7	1.6	2.1	2.28
32	ORCHARD ST S OF DIVISION ST	171/231	318	8	6	240	0.48	0.66	04/15/82	1.70	0.18	1.52	1.24	1.23	7.35	11.08	12.3	59.5	0.73	4.38	7.3	5.1	2.3	2.9	2.26
30	INTERSTATE PL N OF CENTRAL AVE	214/213	282	8	2	60	0.43	0.47	04/15/82	1.14	0.06	1.08	1.24	0.87	5.23	11.05	8.7	74.1	0.65	3.87	6.5	4.5	2.0	2.5	2.25
26	CENTRAL AVE E OF LINCOLN ST	211/210	202	8	5	200	0.31	0.46	04/15/82	1.14	0.15	0.99	1.24	0.80	4.79	10.47	8.0	54.8	0.44	2.63	4.4	3.1	1.4	1.6	2.13
13	LINCOLN ST E OF HOBOKEN RD	144/141	407	8	5	200	0.62	0.77	04/14/82	1.70	0.15	1.55	1.33	1.17	6.99	9.10	11.7	65.8	0.77	4.60	7.7	5.4	2.9	2.5	1.85

Continued on Sheet 2 of 2

FOOTNOTES FOR KERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

CARLSTADT MINISYSTEM D

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS				NORMALIZED INFILTRATION					POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameterxlength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
	SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																								
43	FIRST ST AT CENTRAL AVE	233/220	610	8	21	840	0.92	1.56	04/15/82	1.14	0.63	0.51	1.24	0.41	2.47	1.58	4.1	48.6	0.20	1.20	2.0	1.4	4.4	-3.0	0.32
26	THIRD ST N OF BROAD ST	183/180	964	8	30	1500	1.46	2.60	04/14/82	1.70	0.90	0.80	1.33	0.60	3.61	1.39	6.0	46.1	0.28	1.66	2.8	1.9	6.9	-4.9	0.28
36	SECOND ST N OF CENTRAL AVE	194/193	596	8	17	850	0.90	1.55	04/15/82	0.56	0.41	0.15	1.24	0.12	0.73	0.47	1.2	47.9	0.06	0.35	0.6	0.4	4.3	-3.9	0.10
66	SIXTH ST N OF BERRY AVE	290/280	668	8	19	855	1.01	1.66	04/14/82	0.67	0.57	0.10	1.33	0.08	0.45	0.27	0.8	50.0	0.04	0.23	0.4	0.3	4.8	-4.5	0.06
40	FIRST ST N OF BROAD ST	222/200	650	8	20	1000	0.98	1.74	04/15/82	0.67	0.60	0.07	1.24	0.06	0.34	0.19	0.6	46.3	0.03	0.16	0.3	0.2	4.6	-4.5	0.04
51	MONROE ST N OF BROAD ST	251/240	542	8	19	815	0.82	1.44	04/16/82	0.35	0.35	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	3.9	-3.9	0.00
33	SECOND ST N OF BROAD ST	193/190	951	8	35	1625	1.44	2.67	04/15/82	0.67	0.67	0.00	1.24	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	6.8	-6.8	0.00
30	THIRD ST N OF CENTRAL AVE	185/183	599	8	16	720	0.91	1.45	04/14/82	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.3	-4.3	0.00
73	FIFTH ST N OF PASSAIC AVE	294/291	572	8	14	670	0.87	1.37	04/14/82	0.35	0.35	0.00	1.33	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.1	-4.1	0.00
70	PASSAIC AVE W OF SIXTH ST	291/290	245	8	6	390	0.37	0.67	04/14/82	0.14	0.14	0.00	1.33	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.8	-1.8	0.00
64	SIXTH ST AT DIVISION ST	280/260	1075	8	25	1250	1.63	2.58	04/14/82	0.35	0.35	0.00	1.33	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	7.7	-7.7	0.00
60	SIXTH ST AT BROAD ST	260/100	25	8	0	0	0.04	0.04	04/14/82	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	0.2	-0.2	0.00
	40 SUBTOTAL NOT IN CONTRACT		18019		503	24635	27.29	45.96		39.85	13.30	26.55		20.97	125.79	2.74	209.7	48.4	10.15	60.93	101.5	71.1	129.2	-57.9	0.55
	51 TOTAL		20814		572	28080	31.53	52.81		56.76	15.37	41.39		32.54	195.36	1.69	325.4	49.54	16.12	96.81	161.2	113.1	149.3	-36.0	0.76

FOOTNOTES FOR KERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

CARLSTADT MINISYSTEM F

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS				NORMALIZED INFILTRATION					POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
			Lateral + Trunk		Building Connections		Diameterxlength																		
Reach	Street	Upper/Lower Manhole	Length (ft)	Diameter (in)	Number	Length(ft)	<Ls> (1) (in-mi)	<Lt> (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/ Cost Ratio
	SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13) Cont.																								
29	CENTRAL AVE AT INTERSTATE PL	215/213	259	8	6	180	0.39	0.53	04/15/82	1.14	0.18	0.96	1.24	0.77	4.65	8.78	7.7	60.9	0.47	2.83	4.7	3.3	1.9	1.5	1.79
21	BROAD ST E OF ORCHARD ST	180/170	195	8	10	500	0.30	0.67	04/18/83	4.72	0.30	4.42	4.50	0.98	5.89	8.74	9.8	35.9	0.35	2.12	3.5	2.5	1.4	1.1	1.78
	23 SUBTOTAL IN CONTRACT		9434		102	4505	14.61	18.00		128.18	3.06	125.12		54.59	327.54	18.20	545.9	69.7	38.04	228.29	380.4	267.1	68.7	198.7	3.89
	SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																								
22	BROAD ST E OF LINCOLN ST	181/180	206	8	6	240	0.31	0.49	04/18/83	2.50	0.18	2.32	4.50	0.52	3.09	6.26	5.2	51.8	0.27	1.60	2.7	1.9	1.5	0.4	1.27
33	DIVISION ST E OF GARDEN ST	231/230	284	8	5	225	0.43	0.60	04/15/82	0.80	0.15	0.65	1.24	0.52	3.15	5.24	5.2	58.7	0.31	1.85	3.1	2.2	2.0	0.1	1.07
43	CARLYLE CT (EASTERN PART)	285/282	589	8	14	460	0.89	1.24	04/15/82	1.70	0.42	1.28	1.24	1.03	6.19	4.99	10.3	59.0	0.61	3.65	6.1	4.3	4.2	0.1	1.02
46	CARLYLE CT (EASTERN PART)	293/290	719	8	16	560	1.09	1.51	04/16/82	1.70	0.48	1.22	1.18	1.03	6.20	4.10	10.3	59.0	0.61	3.66	6.1	4.3	5.1	-0.9	0.83
49	GARDEN ST AT CARLYLE CT	290/280	360	8	8	280	0.55	0.76	04/16/82	0.80	0.24	0.56	1.18	0.47	2.85	3.76	4.7	59.0	0.28	1.68	2.8	2.0	2.6	-0.6	0.76
36	GARDEN ST N OF DIVISION ST	250/230	605	8	11	415	0.92	1.23	04/15/82	1.20	0.33	0.87	1.24	0.70	4.21	3.42	7.0	61.1	0.43	2.57	4.3	3.0	4.3	-1.3	0.70
25	LINCOLN ST N OF DIVISION ST	212/210	302	8	6	270	0.46	0.66	04/18/83	1.70	0.18	1.52	4.50	0.34	2.03	3.06	3.4	56.7	0.19	1.15	1.9	1.3	2.2	-0.8	0.62
41	CARLYLE CT E OF GARDEN ST	282/280	1013	8	12	420	1.53	1.85	04/15/82	0.80	0.36	0.44	1.24	0.35	2.13	1.15	3.5	67.9	0.24	1.45	2.4	1.7	7.2	-5.5	0.23
50	INDUSTRIAL AVE N OF PUMP STN	898/P.S.	50	8	0	0	0.08	0.08	04/16/82	0.00	0.00	0.00	1.18	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	0.4	-0.4	0.00
	9 SUBTOTAL NOT IN CONTRACT		4128		78	2870	6.26	8.42		11.20	2.34	8.86		4.96	29.85	3.54	49.6	59.3	2.94	17.61	29.4	20.7	29.5	-8.9	0.70
	32 TOTAL		13562		180	7375	20.87	26.42		139.38	5.40	133.98		59.55	357.39	13.53	595.5	68.8	40.98	245.90	409.8	287.8	98.2	189.8	2.93

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

EAST RUTHERFORD MINISYSTEM J

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)

REACH LOCATION			SEWER REACH DIMENSIONS					
		Upper/Lower	Lateral + Trunk		Building Connections		DiameterxLength	
			Length	Diameter			<Ls> (1)	<Lt> (2)
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)
33	RAILROAD AVE W OF UHLAND ST	210/200	415	8	1	40	0.63	0.66
44	GROVE ST E OF CLINTON PL	235/232	355	8	7	210	0.54	0.70
48	RAILROAD AVE W OF CLINTON PL	250/230	400	15	2	80	1.14	1.20
38	RAILROAD AVE W OF HUMBOLT ST	230/210	425	18	4	150	1.45	1.56
12	RAILROAD AVE W OF BOILING SPR	170/150	465	18	4	150	1.59	1.70
6	PARK AVE N OF UNION AVE	131/130	461	8	8	300	0.70	0.93
45	HUMBOLT ST N OF GROVE ST	236/235	530	8	24	320	0.80	1.05
10	BOILING SPR N OF RAILROAD AVE	152/150	250	8	4	120	0.38	0.47
47	HUMBOLT ST S OF MAIN ST	238/235	230	8	10	300	0.35	0.58
1	UNION AVE E OF VAN WINKLE ST	120/100	500	18	11	330	1.70	1.95
46	GROVE ST E OF HUMBOLT ST	237/235	310	8	16	480	0.47	0.83
8	RAILROAD AVE W OF PARK AVE	150/130	410	18	2	80	1.40	1.46
40	CLINTON PL S OF GROVE ST	232/230	690	8	38	1140	1.05	1.91
2	SUMMER ST N OF UNION AVE	111/110	430	8	11	330	0.65	0.90
52	RAILROAD AVE W OF MOZART ST	L100/250	400	15	1	30	1.14	1.16
37	MAIN ST W OF HUMBOLT ST	214/211	300	8	20	600	0.45	0.91
19	MAIN ST E OF EVERETT PL	185/184	260	8	10	300	0.39	0.62
35	MAIN ST E OF HUMBOLT ST	212/211	325	8	10	350	0.49	0.76
42	CLINTON PL N OF GROVE ST	234/232	710	8	39	1200	1.08	1.98
5	UNION AVE E OF PARK AVE	130/120	320	18	14	560	1.09	1.52
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	20 SUBTOTAL IN CONTRACT		8186		236	7070	17.49	22.85

	ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
33	04/13/83	13.85	0.03	13.82	2.99	4.62	27.73	42.08	46.2	78.2	3.62	21.70	36.2	25.4	3.0	22.4	8.56
44	04/15/83	11.61	0.21	11.40	2.60	4.38	26.31	37.75	43.8	63.3	2.77	16.65	27.7	19.5	2.5	16.9	7.68
48	04/13/83	22.10	0.06	22.04	2.99	7.37	44.23	36.95	73.7	77.8	5.74	34.43	57.4	40.3	5.4	34.9	7.52
38	04/13/83	17.72	0.12	17.60	2.99	5.89	35.32	22.60	58.9	76.0	4.48	26.85	44.8	31.4	6.8	24.6	4.60
12	04/14/83	16.35	0.12	16.23	2.81	5.78	34.65	20.40	57.8	76.5	4.42	26.52	44.2	31.0	7.5	23.5	4.15
6	04/12/82	4.70	0.24	4.46	1.51	2.95	17.72	19.14	29.5	61.9	1.83	10.96	18.3	12.8	3.3	9.5	3.90
45	04/15/83	7.66	0.72	6.94	2.60	2.67	16.02	15.32	26.7	63.0	1.68	10.09	16.8	11.8	3.8	8.0	3.12
10	04/12/82	1.70	0.12	1.58	1.51	1.05	6.28	13.37	10.5	66.1	0.69	4.15	6.9	4.9	1.8	3.1	2.72
47	04/15/83	3.50	0.30	3.20	2.60	1.23	7.38	12.83	12.3	49.6	0.61	3.67	6.1	4.3	1.6	2.6	2.61
1	04/14/83	11.61	0.33	11.28	2.81	4.01	24.09	12.32	40.1	71.5	2.87	17.22	28.7	20.2	8.0	12.1	2.51
46	04/15/83	4.70	0.35	4.35	2.60	1.67	10.04	12.05	16.7	46.2	0.77	4.64	7.7	5.4	2.2	3.2	2.45
8	04/14/83	7.66	0.06	7.60	2.81	2.70	16.23	11.13	27.0	78.6	2.13	12.75	21.3	14.9	6.6	8.3	2.26
40	04/15/83	9.50	1.14	8.36	2.60	3.22	19.29	10.11	32.2	44.9	1.44	8.66	14.4	10.1	4.9	5.2	2.06
2	04/12/82	2.50	0.33	2.17	1.51	1.44	8.62	9.56	14.4	59.3	0.85	5.11	8.5	6.0	3.1	2.9	1.95
52	04/13/82	2.50	0.03	2.47	1.35	1.83	10.98	9.47	18.3	80.4	1.47	8.83	14.7	10.3	5.4	5.0	1.93
37	04/13/82	2.50	0.60	1.90	1.35	1.41	8.44	9.29	14.1	41.0	0.58	3.46	5.8	4.1	2.1	1.9	1.89
19	04/12/82	1.70	0.30	1.40	1.51	0.93	5.56	8.95	9.3	52.0	0.48	2.89	4.8	3.4	1.9	1.5	1.82
35	04/13/82	1.70	0.30	1.40	1.35	1.04	6.22	8.21	10.4	53.3	0.55	3.32	5.5	3.9	2.3	1.6	1.67
42	04/15/83	7.66	0.67	6.99	2.60	2.69	16.13	8.13	26.9	44.4	1.19	7.17	11.9	8.4	5.1	3.3	1.65
5	04/14/83	6.09	0.42	5.67	2.81	2.02	12.11	7.99	20.2	59.0	1.19	7.15	11.9	8.4	5.1	3.2	1.63
		-----	-----	-----		-----	-----	-----	-----	-----	------	-----	-----	----	----	----	----
SUBTOTAL		157.31	6.45	150.86		58.90	353.35	15.46	589.0	66.8	39.36	236.22	393.6	276.5	82.4	193.7	3.36

Continued on Sheet 2 of 2

FOOTNOTES FOR KERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RERC JOINT MEETING

SUMMARY OF RECOMMENDED I/I REDUCTION PROGRAM

	Average Flow Reduction (gpd)				Peak Flow Reduction (gpd)				Overall Cost-Effectiveness		
	Carlstadt	E. Rutherford	Rutherford	RERC-JM	Carlstadt	E. Rutherford	Rutherford	RERC-JM	1981 Benefit ($1000)(1)	1981 Cost ($1000)(2)	Benefit/Cost Ratio
Test and Seal (CTAG) Program (3)											
Infiltration Reduction	101,600	39,400	102,700	243,700	1,015,600	393,600	1,026,900	2,436,100	1,678.7	456.5	3.7
Indirect Inflow Reduction	-	200	1,800	2,000	-	6,400	55,100	61,500	40.6	24.2	1.7
Subtotals	101,600	39,600	104,500	245,700	1,015,600	400,000	1,082,000	2,497,600	1,719.3	480.7	3.6
Program to Reduce I/I from Specific Sources (4)											
Catch Basin Diversion	-	700	3,400	4,100	-	85,200	402,800	488,000	314.2	54.0	5.8
Storm System Disconnection	-	-	1,000	1,000	-	-	120,000	120,000	77.4	12.5	6.2
Leaky Manhole Repair	300	1,000	800	2,100	3,200	9,700	8,300	21,200	14.9	5.4	2.8
Manhole Cover Replacement	400	-	-	400	54,000	-	-	54,000	34.8	1.2	29.0
Subtotals	700	1,700	5,200	7,600	57,200	94,900	531,100	683,200	441.3	73.1	6.0
Program to Reduce I/I from Sources on Private Property (5)											
Roof Drain Diversions	3,000	700	100	3,800	360,000	79,200	9,000	448,200	288.9	2.1	137.6
Surface Drain Diversion	500	-	100	600	62,300	-	17,600	79,900	51.6	1.9	27.2
Subtotals	3,500	700	200	4,400	422,300	79,200	26,600	528,100	340.5	4.0	85.1
RERC-JM TOTALS	105,800	42,000	109,900	257,700	1,495,100	574,100	1,639,700	3,708,900	2,501.1	557.8	4.5

Notes:

(1) Overall benefit based on USEPA criteria.
(2) For estimated 1984 costs, see Table 1b.
(3) See Table 3.
(4) See Table 4.
(5) See Table 5.

RERC JOINT MEETING

COST-EFFECTIVENESS OF LOCALLY IMPLEMENTED I/I REDUCTION PROGRAM

	Revised 1984 Cost Estimate ($) (1)				Initial Annual Reduction of BCUA Charge to Locality ($) (2)				Time Required to Recover Costs (years) (3)			
	Carlstadt	E. Rutherford	Rutherford	RERC-JM	Carlstadt	E. Rutherford	Rutherford	RERC-JM	Carlstadt	E. Rutherford	Rutherford	RERC-JM
Test-and-Seal (CTAG) Program												
Infiltration Reduction	117,100	61,800	163,500	342,400	19,910	7,680	20,330	47,000	7	10	10	9
Indirect Inflow Reduction	-	1,900	16,300	18,200	-	40	360	400	-	30+	30+	30+
Subtotals	117,100	63,700	179,800	360,600	19,910	7,720	20,690	47,400	7	11	11	10
Program to Reduce I/I from Specific Sources												
Catch Basin Diversion	-	16,800	48,000	64,800	-	140	700	800	-	30+	30+	30+
Storm System Disconnection	-	-	15,000	15,000	-	-	200	200	-	-	30+	30+
Leaky Manhole Repair	1,200	2,600	2,600	6,400	60	200	160	400	30+	19	28	27
Manhole Cover Replacement	1,400	-	-	1,400	90	-	-	90	25	-	-	26
Subtotals	2,600	19,400	65,600	87,600	150	340	1,060	1,490	30+	30+	30+	30+
Program to Reduce I/I from Sources on Private Property												
Roof Drain Diversions	400	1,400	700	2,500	600	140	20	710	1	13	30+	4
Surface Drain Diversion	700	-	1,600	2,300	100	-	30	140	9	-	30+	28
Subtotals	1,100	1,400	2,300	4,800	700	140	50	850	2	13	30+	7
RERC-JM TOTALS	120,800	84,500	247,700	453,000	20,760	8,200	21,800	49,740	7	14	16	12

Notes:

(1) Test-and-seal costs were reduced 25% from those indicated in Table 1a based on recent actual bid prices. Other costs were increased 20% based on inflation.

(2) Based on the formula in Section VIII, BCUA total flow = 67 mgd, and RERC-JM average flows indicated in Table 1, the annual BCUA user charge reductions per gpd that the average I/I is reduced are as follows: Carlstadt = $0.196; East Rutherford = $0.195; Rutherford = $0.198; RERC-JM = $0.193.

(3) Based on an 8% interest rate; the initial debt service payment equal to the indicated initial reduction of BCUA charge; and a 4% increase in debt service payment per year (based on estimated inflation of BCUA charges).

RERC JOINT MEETING

SUMMARY OF MINISYSTEM INFILTRATION RATES AND DIMENSIONS

RERC-JM Borough	Mini-system	Normalized Average Infiltration (1000 gpd): 1979 Estimate(1)	Based on 1982-1983 Flow Isolation(2)	1984 Estimate(3)	Dimensions (4): L (5) (miles)	Lt (6) (inch-miles)	7-Day Max Unit Infiltration Rate (7) (1000 gpd/in-mi)	Flow Isolation Completed
Carlstadt	A	218	42	46	0.8	10.1	27.3	Yes
	B	68	48	69	4.4	50.9	8.1	Yes
	C	2	1	5	0.9	10.1	3.0	No
	D	55	33	55	3.9	52.8	6.3	Yes
	E	5	4	15	2.3	26.6	3.4	No
	F	164	60	71	2.6	26.4	16.1	Yes
Subtotals		512	188	261	14.9	176.9	8.9	
East Rutherford	G	4	3	12	1.3	22.6	3.2	No
	H	6	4	17	2.3	31.1	3.3	No
	I	6	4	19	3.3	37.5	3.0	No
	J	145	66	82	2.6	39.6	12.4	Yes
	K	3	2	9	1.3	16.3	3.3	No
	L	25	17	27	2.5	35.7	4.5	No
Subtotals		189	96	166	13.3	182.8	5.4	
Rutherford	M	79	104	125	3.7	51.8	14.5	Yes
	N	42	9	17	1.8	20.1	5.1	Yes
	O	5	4	15	1.8	27.7	3.2	No
	P	34	23	33	1.8	25.2	7.9	Yes
	Q	39	41	54	2.4	31.2	10.4	Yes
	R	47	59	75	3.6	39.4	11.4	Yes
	S	12	8	16	1.7	19.4	4.9	No
	T	5	4	13	1.8	21.2	3.7	No
	U	33	12	17	0.6	12.1	8.4	Yes
	UM	3	2	9	0.6	16.1	3.4	No
Subtotals		299	266	374	19.8	264.2	8.5	
RERC-JM TOTALS		1000	550	801	48.0	623.9	7.7	

Notes:

(1) From revised Table 8 in Facility Plan.
(2) Based on Tables 3a in flow isolated minisystems; and on 0.69 x infiltration in Facility Plan Revised Table 8 in non-isolated minisystems. The 0.69 factor reduces flow in non-isolated minisystems proportional to flow reductions in isolated minisystems.
(3) Infiltration based on previous column + 400 gpd per inch-mile. The 400 gpd/in.-mi. uniformly distributes the difference between RERC-JM total in this column and previous column.
(4) From revised Table 8 in Facility Plan in most non-isolated minisystems.
(5) Length of municipal and RERC-JM sewer excluding building connections.
(6) Diameter-length of all sanitary sewers including building connections.
(7) Based on 6 x normalized average infiltration/Lt.

RERC JOINT MEETING

SUMMARY OF RECOMMENDED PROGRAM TO REDUCE I/I BY TESTING AND SEALING SEWER JOINTS

RERC-JM		Infiltration Reduction (1)					Indirect Inflow Reduction(2)				Total Test-and-Seal Program			
		Est Diam Length		Flow Reduction (gpd)		Cost	Flow Reduction (gpd)			Cost	Flow Reduction (gpd)		Benefit	Cost
Borough	Minisystem	(pct)(3)	Ls(in-mi)(4)	Avg	Peak	($1000)	Ls(in-mi)(4)	Avg	Peak	($1000)	Avg	Peak	($1000)(6)	($1000)(5)
Carlstadt	A	91	8.94	31,900	319,000	42.1	-	-	-	-	31,900	319,000	224.0	42.1
	B	13	5.35	25,650	256,500	25.2	-	-	-	-	25,650	256,500	180.0	25.2
	C	-	-	-	-	-	-	-	-	-	-	-	-	-
	D	13	4.24	5,970	59,700	20.1	-	-	-	-	5,970	59,700	42.0	20.1
	E	-	-	-	-	-	-	-	-	-	-	-	-	-
	F	70	14.61	38,040	380,400	68.7	-	-	-	-	38,040	380,400	267.1	68.7
Subtotals			33.14	101,560	1,015,600	156.1	-	-	-	-	101,560	1,015,600	713.1	156.0
E. Rutherford	G	-	-	-	-	-	-	-	-	-	-	-	-	-
	H	-	-	-	-	-	-	-	-	-	-	-	-	-
	I	-	-	-	-	-	-	-	-	-	-	-	-	-
	J	64	17.49	39,360	393,600	82.4	-	-	-	-	39,360	393,600	276.5	82.4
	K	-	-	-	-	-	-	-	-	-	-	-	-	-
	L	-	-	-	-	-	0.53	210	6,360	2.49	210	6,360	4.2	2.5
Subtotals			17.49	39,360	393,600	82.4	0.53	210	6,360	2.49	39,570	399,960	280.7	84.9
Rutherford	M	39	12.11	43,610	436,100	57.3	0.48	190	5,760	2.26	43,800	441,860	309.9	59.6
	N	8	1.25	1,680	16,800	6.0	-	-	-	-	1,680	16,800	11.0	6.0
	O	-	-	-	-	-	-	-	-	-	-	-	-	-
	P	37	5.25	8,750	87,500	25.0	1.67	670	20,100	7.88	9,420	107,600	74.8	32.9
	Q	53	10.26	17,910	179,100	48.3	-	-	-	-	17,910	179,100	116.4	48.3
	R	52	15.15	28,350	283,500	71.5	1.00	400	12,000	4.72	28,750	295,500	191.9	76.2
	S	-	-	-	-	-	0.61	240	7,200	2.88	240	7,200	4.7	2.9
	T	-	-	-	-	-	-	-	-	-	-	-	-	-
	U	19	2.1	2,390	23,900	9.9	0.84	340	10,080	3.96	2,730	33,980	16.8	13.9
	UM	-	-	-	-	-	-	-	-	-				
Subtotals			46.12	102,690	1,026,900	218.0	4.60	1,840	55,140	21.70	104,530	1,082,040	725.6	239.8
RERC-JM TOTALS			96.75	243,610	2,436,100	456.5	5.13	2,050	61,500	24.19	245,660	2,497,600	1719.3	480.7

Notes:

(1) For details, see Tables 3a-A through 3a-U.
(2) For details, see Table 3b
(3) Percent of minisystem diameter-length , Ls, which is overal cost-effective for test-and-seal based on unit infiltration rates.
(4) Ls = diameter-length of trunk and lateral sewers in test-and-seal program noted.
(5) Based on 1981 estimate, 1984 costs are estimated to be 25 percent lower.
(6) Overall 1981 benefit based on $0.64 per gpd that the peak flow is reduced and $0.60 per gpd that the average flow is reduced.

CARLSTADT MINISYSTEM A

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameterxlength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																
1	SIXTEENTH ST N OF BROAD ST	102/100	410	12	3	100	0.93	1.01	04/16/82	9.50	0.09	9.41	1.18	7.97	47.85	47.49	79.7	75.8	6.05	36.28	60.5	42.5	4.4	38.1	9.66
6	BROAD ST W OF EIGHTEENTH ST	130/100	680	18	2	65	2.32	2.37	04/16/82	16.35	0.06	16.29	1.18	13.81	82.83	34.99	138.1	80.3	11.08	66.51	110.8	77.8	10.9	66.9	7.12
11	BROAD ST E OF EIGHTEENTH ST	142/130	947	12	3	100	2.15	2.23	04/16/82	11.60	0.09	11.51	1.18	9.75	58.53	26.27	97.5	79.2	7.73	46.36	77.3	54.2	10.1	44.1	5.34
3	SIXTEENTH ST N OF BROAD ST	105/102	605	12	2	65	1.38	1.42	04/16/82	6.10	0.06	6.04	1.18	5.12	30.71	21.56	51.2	79.2	4.05	24.31	40.5	28.4	6.5	22.0	4.39
18	BROAD ST E OF TWENTIETH ST	147/145	412	12	3	90	0.94	1.00	04/16/82	2.50	0.09	2.41	1.18	2.04	12.25	12.20	20.4	76.4	1.56	9.37	15.6	11.0	4.4	6.5	2.48
15	BROAD ST E OF TWENTIETH ST	145/142	538	12	2	60	1.22	1.27	04/16/82	2.20	0.06	2.14	1.18	1.81	10.88	8.58	18.1	79.1	1.43	8.60	14.3	10.1	5.8	4.3	1.75
	6 SUBTOTAL IN CONTRACT		3592		15	480	8.94	9.30		48.25	0.45	47.80		40.50	243.05	26.13	405.0	78.8	31.90	191.43	319.0	224.0	42.1	181.9	5.32
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																
9	EMPTY LOT S OF BROAD ST	132/130	525	8	0	0	0.80	0.80	04/16/82	1.14	0.00	1.14	1.18	0.97	5.80	7.29	9.7	82.0	0.79	4.75	7.9	5.6	3.8	1.8	1.48
	1 SUBTOTAL NOT IN CONTRACT		525		0	0	0.80	0.80		1.14	0.00	1.14		0.97	5.80	7.25	9.7	82.0	0.79	4.75	7.9	5.6	3.8	1.8	1.48
	7 TOTAL		4117		15	480	9.74	10.10		49.39	0.45	48.94		41.47	248.85	24.64	414.7	78.8	32.69	196.18	326.9	229.6	45.9	183.7	5.00

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

EAST RUTHERFORD MINISYSTEM J

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
Reach	Street	Upper/Lower Manhole	Lateral + Trunk Length (ft)	Lateral + Trunk Diameter (in)	Building Connections Number	Building Connections Length(ft)	Diameter x length (Ls) (1) (in-mi)	Diameter x length (Lt) (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/Cost Ratio
	SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																								
25	MAIN ST E OF UHLAND ST	203/202	275	8	15	450	0.42	0.76	04/13/82	1.70	0.45	1.25	1.45	0.86	5.17	6.83	8.6	45.1	0.39	2.33	3.9	2.7	2.0	0.8	1.39
29	GROVE ST W OF BOILING SPRING	208/205	540	8	32	980	0.82	1.56	04/13/82	2.50	0.96	1.54	1.35	1.14	6.84	4.39	11.4	43.0	0.49	2.94	4.9	3.4	3.9	-0.4	0.89
50	MOZART ST S OF GROVE ST	K100/250	215	12	11	440	0.49	0.82	04/13/82	1.14	0.33	0.81	1.35	0.60	3.60	4.38	6.0	48.7	0.29	1.75	2.9	2.1	2.3	-0.3	0.89
4	VAN WINKLE ST N OF UNION AVE	121/120	400	8	50	2000	0.61	2.12	04/12/82	3.50	1.50	2.00	1.51	1.32	7.95	3.75	13.2	23.4	0.31	1.86	3.1	2.2	2.9	-0.7	0.76
14	UNION AVE W OF EVERETT PL	200/170	480	18	3	120	1.64	1.73	04/12/82	1.36	0.09	1.27	1.51	0.84	5.05	2.92	8.4	77.7	0.65	3.92	6.5	4.6	7.7	-3.1	0.59
28	UHLAND ST N OF GROVE ST	206/205	320	8	20	600	0.48	0.94	04/13/82	1.14	0.60	0.54	1.35	0.40	2.40	2.55	4.0	42.3	0.17	1.02	1.7	1.2	2.3	-1.1	0.52
34	HUMBOLT ST E OF MAIN ST	211/210	290	8	6	180	0.44	0.58	04/13/82	0.47	0.18	0.29	1.35	0.21	1.29	2.24	2.1	62.6	0.13	0.81	1.3	0.9	2.1	-1.1	0.46
20	EVERETT PL N OF MAIN ST	186/184	225	8	11	363	0.34	0.62	04/12/82	0.67	0.33	0.34	1.51	0.23	1.35	2.19	2.3	45.4	0.10	0.61	1.0	0.7	1.6	-0.9	0.45
32	EVERETT PL S OF GROVE ST	209/207	370	8	11	330	0.56	0.81	04/13/82	0.67	0.33	0.34	1.35	0.25	1.51	1.86	2.5	56.7	0.14	0.86	1.4	1.0	2.6	-1.6	0.38
15	ORCHAR ST E OF EVERETT PL	182/180	275	8	13	325	0.42	0.66	04/12/82	0.67	0.39	0.28	1.51	0.19	1.11	1.68	1.9	51.5	0.10	0.57	1.0	0.7	2.0	-1.3	0.34
17	EVERETT PL S OF MAIN ST	184/180	790	8	37	1295	1.20	2.18	04/12/82	1.83	1.11	0.72	1.51	0.48	2.86	1.31	4.8	45.1	0.21	1.29	2.1	1.5	5.6	-4.1	0.27
36	HUMBOLT ST N OF MAIN ST	213/211	355	8	15	450	0.54	0.88	04/13/82	0.67	0.45	0.22	1.35	0.16	0.98	1.11	1.6	50.2	0.08	0.49	0.8	0.6	2.5	-2.0	0.23
23	UHLAND ST S OF MAIN ST	202/200	530	8	21	630	0.80	1.28	04/13/82	0.79	0.63	0.16	1.35	0.12	0.71	0.56	1.2	51.4	0.06	0.37	0.6	0.4	3.8	-3.4	0.11
26	UHLAND ST N OF MAIN ST	205/202	635	8	36	1080	0.96	1.78	04/13/82	0.35	0.35	0.00	1.35	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.5	-4.5	0.00
	14 SUBTOTAL NOT IN CONTRACT		5700		281	9243	9.72	16.72		17.46	7.70	9.76		6.80	40.82	2.44	68.0	45.9	3.12	18.82	31.2	22.0	45.8	-23.7	0.48
	34 TOTAL		13886		517	16313	27.21	39.57		174.77	14.15	160.62		65.70	394.17	9.96	657.0	64.7	42.48	255.04	424.8	298.5	128.2	170.0	2.33

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM M

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
Reach	Street	Upper/Lower Manhole	Lateral + Trunk Length (ft)	Lateral + Trunk Diameter (in)	Building Connections Number	Building Connections Length(ft)	Diameterxlength <Ls> (1) (in-mi)	Diameterxlength <Lt> (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/Cost Ratio
SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																									
67	PIERREPONT AVE W OF ORIENT WAY	294/290	315	8	5	250	0.48	0.67	04/19/83	3.01	0.15	2.86	4.00	0.72	4.29	6.44	7.2	58.7	0.42	2.52	4.2	2.9	2.3	0.7	1.31
37	WILLIAMS ST W OF FERONIA WAY	221/220	307	8	11	605	0.47	0.92	04/12/82	1.70	0.33	1.37	1.51	0.91	5.44	5.89	9.1	41.3	0.37	2.25	3.7	2.6	2.2	0.4	1.20
60	CROFT PKWY AT ELYCROFT PKY	271/270	203	8	8	440	0.31	0.64	04/12/82	1.14	0.24	0.90	1.51	0.60	3.58	5.58	6.0	39.4	0.23	1.41	2.3	1.6	1.5	0.2	1.14
75	VAN RIPER AVE W OF ORIENT WAY	342/340	692	8	20	1165	1.05	1.93	04/18/83	7.66	0.32	7.34	4.50	1.63	9.79	5.07	16.3	44.5	0.73	4.36	7.3	5.1	4.9	0.2	1.03
82	BARROWS WAY W OF ORIENT WAY	355/352	520	8	16	960	0.79	1.52	04/18/83	6.10	0.48	5.62	4.50	1.25	7.49	4.95	12.5	42.6	0.53	3.20	5.3	3.7	3.7	0.0	1.01
78	LYNN CT W OF VAN RIPER AVE	344/342	189	8	6	210	0.29	0.45	04/09/82	0.67	0.18	0.49	1.57	0.31	1.87	4.20	3.1	52.7	0.16	0.99	1.6	1.2	1.4	-0.2	0.86
3	BOLIVER ST W OF ROUTE 17	112/110	313	8	10	500	0.47	0.85	04/09/82	1.14	0.30	0.84	1.57	0.54	3.21	3.76	5.4	45.6	0.24	1.46	2.4	1.7	2.2	-0.5	0.77
55	ARTHUR DR S OF CRANE AVE	274/273	128	8	7	420	0.19	0.51	04/12/82	0.67	0.21	0.46	1.51	0.30	1.83	3.57	3.0	31.1	0.09	0.57	0.9	0.7	0.9	-0.3	0.73
51	ARTHUR DR S OF CRANE AVE	262/273	355	8	11	550	0.54	0.95	04/12/82	1.14	0.33	0.81	1.51	0.54	3.22	3.37	5.4	46.2	0.25	1.49	2.5	1.7	2.5	-0.8	0.69
10	ROUTE 17 S OF NEVINS ST	144/142	288	12	2	150	0.65	0.77	04/09/82	0.67	0.06	0.61	1.57	0.39	2.33	3.03	3.9	69.9	0.27	1.63	2.7	1.9	3.1	-1.2	0.62
66	GARFIELD PL W OF ORIENT WAY	293/291	265	8	6	300	0.40	0.63	04/09/82	0.67	0.18	0.49	1.57	0.31	1.87	2.98	3.1	52.4	0.16	0.98	1.6	1.1	1.9	-0.7	0.61
79	VAN RIPER AVE W OF LYNN CT	343/342	288	8	6	340	0.44	0.69	04/18/83	1.70	0.18	1.52	4.50	0.34	2.03	2.92	3.4	51.6	0.17	1.05	1.7	1.2	2.1	-0.8	0.59
71	WOODLAND AVE W OF ORIENT WAY	322/320	315	8	5	300	0.48	0.70	04/09/82	0.67	0.15	0.52	1.57	0.33	1.99	2.82	3.3	55.5	0.18	1.10	1.8	1.3	2.3	-1.0	0.57
49	CRANE AVE AT ARTHUR DRIVE	262/260	427	8	13	650	0.65	1.14	04/12/82	1.14	0.39	0.75	1.51	0.50	2.98	2.62	5.0	46.6	0.23	1.39	2.3	1.6	3.1	-1.4	0.53
16	EVANS AVE W & E OF HIGHFIELD	185/160	391	8	11	575	0.59	1.03	04/09/82	1.03	0.33	0.70	1.57	0.45	2.68	2.60	4.5	47.3	0.21	1.26	2.1	1.5	2.8	-1.3	0.53
35	FERONIA WAY S OF PIERREPONT AV	210/200	226	8	4	200	0.34	0.49	04/09/82	0.35	0.12	0.23	1.57	0.15	0.88	1.78	1.5	56.8	0.08	0.50	0.8	0.6	1.6	-1.0	0.36
18	HIGHFIELD LN S OF EVANS AVE	182/180	293	8	10	500	0.44	0.82	04/09/82	0.67	0.30	0.37	1.57	0.24	1.41	1.72	2.4	44.2	0.10	0.63	1.0	0.7	2.1	-1.4	0.35
14	CROFT PKWY S OF PIERREPONT AVE	184/150	961	8	32	1760	1.46	2.79	04/09/82	2.15	0.96	1.19	1.57	0.76	4.55	1.63	7.6	42.8	0.32	1.95	3.2	2.3	6.9	-4.6	0.33
45	FERONIA WAY S OF CRAN AVE	253/250	507	8	20	1100	0.77	1.60	04/12/82	1.14	0.60	0.54	1.51	0.36	2.15	1.34	3.6	39.3	0.14	0.84	1.4	1.0	3.6	-2.6	0.27
13	BERBE PARK S OF RT 17	150/140	240	8	9	450	0.36	0.70	04/09/82	0.51	0.27	0.24	1.57	0.15	0.92	1.30	1.5	42.3	0.06	0.39	0.6	0.5	1.7	-1.3	0.26
36	FERONIA WAY W OF EVANS AVE	210/230	526	8	14	700	0.80	1.33	04/12/82	0.67	0.42	0.25	1.51	0.17	0.99	0.75	1.7	49.2	0.08	0.49	0.8	0.6	3.8	-3.2	0.15

Continued on Sheet 3 of 3

FOOTNOTES FOR KERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM M

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameterxlength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																									
62	PIERREPONT AVE W OF FERONIA WY	290/200	341	8	10	500	0.52	0.90	04/19/83	43.95	0.30	43.65	4.00	10.91	65.48	73.12	109.1	47.3	5.16	30.98	51.6	36.2	2.4	33.8	14.88
43	FERONIA WAY AT NEVINS ST	240/250	345	8	11	550	0.52	0.94	04/19/83	42.33	0.33	42.00	4.00	10.50	63.00	67.06	105.0	45.6	4.79	28.75	47.9	33.6	2.5	31.2	13.65
81	ORIENT WAY E OF VAN RIPER	350/340	256	8	10	750	0.39	0.96	04/18/83	47.15	0.30	46.85	4.50	10.41	62.47	65.34	104.1	33.3	3.46	20.78	34.6	24.3	1.8	22.5	13.29
44	CRANE AVE W OF FERONIA WAY	251/250	198	8	7	385	0.30	0.59	04/19/83	24.52	0.21	24.31	4.00	6.08	36.47	61.63	60.8	41.6	2.53	15.16	25.3	17.7	1.4	16.3	12.54
26	PIERREPONT AVE W OF ROUTE 17	190/150	253	8	15	780	0.38	0.97	04/19/83	30.00	0.45	29.55	4.00	7.39	44.33	45.50	73.9	32.3	2.38	14.30	23.8	16.7	1.8	14.9	9.26
68	ORIENT WAY S OF PIERREPONT AVE	320/290	905	8	6	390	1.37	1.67	04/19/83	33.12	0.18	32.94	4.00	8.24	49.41	29.65	82.4	67.5	5.56	33.33	55.6	39.0	6.5	32.5	6.03
33	FERONIA WAY S OF SUMMIT CROSS	204/200	782	8	26	1300	1.18	2.17	04/19/83	36.70	0.78	35.92	4.00	8.98	53.88	24.83	89.8	44.8	4.02	24.13	40.2	28.2	5.6	22.6	5.05
12	CRANE AVE @ ROUTE 17	270/140	1593	8	17	1075	2.41	3.23	04/19/83	50.10	0.51	49.59	4.00	12.40	74.39	23.04	124.0	61.3	7.60	45.61	76.0	53.4	11.4	42.0	4.69
64	ORIENT WAY N OF PIERREPONT AVE	292/290	477	8	13	815	0.72	1.34	04/19/83	16.35	0.39	15.96	4.00	3.99	23.94	17.86	39.9	44.2	1.76	10.59	17.6	12.4	3.4	9.0	3.63
48	CRANE AVE E OF FERONIA AVE	250/260	329	8	8	400	0.50	0.80	04/19/83	9.50	0.24	9.26	4.00	2.32	13.89	17.33	23.2	51.0	1.18	7.08	11.8	8.3	2.4	5.9	3.53
1	ROUTE 17 OF N OF PIERREPONT AV	140/100	756	12	8	585	1.72	2.16	04/19/83	15.80	0.24	15.56	4.00	3.89	23.34	10.80	38.9	65.2	2.54	15.21	25.4	17.8	8.1	9.7	2.20
40	NEVINS ST W OF FERONIA WAY	231/230	296	8	9	495	0.45	0.82	04/12/82	2.50	0.27	2.23	1.51	1.48	8.86	10.76	14.8	44.7	0.66	3.96	6.6	4.6	2.1	2.5	2.19
85	BARROWS AVE W OF ORIENT WAY	352/350	386	8	9	540	0.58	0.99	04/18/83	7.66	0.27	7.39	4.50	1.64	9.85	9.91	16.4	48.3	0.79	4.75	7.9	5.6	2.8	2.8	2.02
47A	FERONIA WAY S OF VAN RIPER AVE	255/253	125	8	2	100	0.19	0.27	04/12/82	0.67	0.06	0.61	1.51	0.40	2.42	9.14	4.0	58.6	0.24	1.42	2.4	1.7	0.9	0.8	1.86
41	NEVINS ST E OF FERONIA WAY	241/240	289	8	7	385	0.44	0.73	04/12/82	1.70	0.21	1.49	1.51	0.99	5.92	8.12	9.9	49.2	0.49	2.91	4.9	3.4	2.1	1.3	1.65
56	ARTHUR DR E OF CRANE AVE	273/270	288	8	8	440	0.44	0.77	04/12/82	1.70	0.24	1.46	1.51	0.97	5.80	7.54	9.7	46.5	0.45	2.70	4.5	3.2	2.1	1.1	1.53
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	16 SUBTOTAL IN CONTRACT		7619		166	9490	12.11	19.31		363.75	4.98	358.77		90.59	543.45	28.14	905.9	48.1	43.61	261.66	436.1	306.1	57.3	248.9	5.34
SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																									
47	VAN RIPER AVE W OF FERONIA WAY	254/253	206	8	6	350	0.31	0.58	04/12/82	1.14	0.18	0.96	1.51	0.64	3.81	6.61	6.4	44.3	0.28	1.69	2.8	2.0	1.5	0.5	1.34
5	ELIZABETH ST W OF ROUTE 17	131/120	295	8	10	500	0.45	0.83	04/09/82	1.70	0.30	1.40	1.57	0.89	5.35	6.48	8.9	44.4	0.40	2.37	4.0	2.8	2.1	0.7	1.32

Continued on Sheet 2 of 3

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.
2) Includes building connections.
3) Measured between 2 a.m. and 6 a.m. on indicated date.
4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.
5) Measured infiltration = measured flow - night base flow.
6) Ground water index = ratio of measured infiltration rate to average infiltration rate.
7) Average infiltration = measured infiltration divided by ground water index.
8) The 7-day-max. infiltration = 6 x average infiltration.
9) Peak infiltration = 10 x average infiltration.
10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.
11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.
12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.
13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.
14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM M

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameterxlength			Net Flow (3)	Night Base Flow (4)	Measured Infiltration(5)	Ground Water	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of CTAG (12)	Net Benefit	Benefit/ Cost
Reach	Street	Manhole	Length (ft)	Diameter (in)	Number	Length(ft)	<Ls> (1) (in-mi)	<Lt> (2) (in-mi)	Date	(1000 gpd)	(1000 gpd)	(10CJ gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																
8	ROUTE 17 W OF PIERREPONT AVE	142/140	997	12	3	225	2.27	2.44	04/09/82	0.47	0.09	0.38	1.57	0.24	1.45	0.60	2.4	76.3	0.18	1.11	1.8	1.3	10.7	-9.4	0.12
27	EASTERN WAY N OF PIERREPONT AV	193/190	716	8	28	1540	1.08	2.25	04/09/82	1.14	0.84	0.30	1.57	0.19	1.15	0.51	1.9	39.5	0.08	0.45	0.8	0.5	5.1	-4.6	0.10
30	PIERREPONT AVE W OF EASTERN WY	200/190	266	8	9	450	0.40	0.74	04/09/82	0.32	0.27	0.05	1.57	0.03	0.19	0.26	0.3	44.4	0.01	0.08	0.1	0.1	1.9	-1.8	0.05
73	ORIENT WAY S OF WOODLAND AVE	340/320	741	8	17	1285	1.12	2.10	04/09/82	0.35	0.35	0.00	1.57	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	5.3	-5.3	0.00
61	CRANE ST S ELY CROFT PKWY	270/260	254	8	12	660	0.38	0.88	04/12/82	0.25	0.25	0.00	1.51	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.8	-1.8	0.00
20	HIGHFIELD LN AT NEVINS ST	182/184	579	8	15	750	0.88	1.45	04/09/82	0.35	0.35	0.00	1.57	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.1	-4.1	0.00
39	FERONIA AVE @ NEVINS ST	240/250	66	8	0	0	0.10	0.10	04/19/83	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	0.5	-0.5	0.00
	30 SUBTOTAL NOT IN CONTRACT		11869		326	17885	18.96	32.50		40.32	9.13	31.19		12.94	77.45	2.38	129.4	46.1	5.97	36.16	59.7	42.2	89.6	-47.1	0.47
	46 TOTAL		19488		492	27375	31.07	51.81		404.07	14.11	389.96		103.53	620.90	11.98	1035.3	47.9	49.58	297.82	495.8	348.3	146.9	201.8	2.37

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for cost-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM N

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS				NORMALIZED INFILTRATION					POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
Beach	Street	Upper/Lower Manhole	Lateral + Trunk Length (ft)	Lateral + Trunk Diameter (in)	Building Connections Number	Building Connections Length(ft)	DiameterxLength <Ls> (1) (in-mi)	DiameterxLength <Lt> (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/Cost Ratio
SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																									
10	WINSLOW PL W OF ORIENT WAY	180/160	385	8	1	30	0.58	0.61	04/12/82	1.70	0.03	1.67	1.51	1.11	6.64	10.95	11.1	78.9	0.87	5.24	8.7	5.7	2.8	2.9	2.06
32	PIERREPONT W OF SYLVAN ST	310/300	210	8	2	60	0.32	0.36	04/12/82	0.89	0.06	0.83	1.51	0.55	3.30	9.07	5.5	71.8	0.39	2.37	3.9	2.6	1.5	1.1	1.71
36	MOUNTAIN WAY N OF WOODLAND AVE	260/240	233	8	6	180	0.35	0.49	04/13/82	1.14	0.18	0.96	1.35	0.71	4.27	8.72	7.1	59.2	0.42	2.52	4.2	2.7	1.7	1.1	1.64
	3 SUBTOTAL IN CONTRACT		828		9	270	1.25	1.46		3.73	0.27	3.46		2.37	14.21	9.73	23.7	71.0	1.68	10.13	16.8	11.0	6.0	5.1	1.83
SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																									
45	WOODLAND AVE W OF SYLVAN ST	283/280	200	8	3	90	0.30	0.37	04/13/82	0.67	0.09	0.58	1.35	0.43	2.58	6.94	4.3	66.9	0.29	1.73	2.9	1.9	1.4	0.4	1.31
7	ORIENT WAY S OF SUMMIT CROSS	160/140	381	10	11	330	0.72	0.97	04/12/82	1.80	0.33	1.47	1.51	0.97	5.84	6.01	9.7	60.9	0.59	3.56	5.9	3.9	3.4	0.5	1.13
20	MOUNTAIN WAY S OF WINSLOW PL	200/180	265	8	9	270	0.40	0.61	04/12/82	1.03	0.27	0.76	1.51	0.50	3.02	4.98	5.0	54.3	0.27	1.64	2.7	1.8	1.9	-0.1	0.94
1	SUMMIT CROSS AT EASTERN WAY	120/100	460	10	8	240	0.87	1.05	04/12/82	1.35	0.24	1.11	1.51	0.74	4.41	4.19	7.4	67.8	0.50	2.99	5.0	3.2	4.1	-0.9	0.79
43	SYLVAN AVE S OF WOODLAND AVE	282/280	585	8	18	540	0.89	1.30	04/13/82	1.70	0.54	1.16	1.35	0.86	5.16	3.98	8.6	56.1	0.48	2.89	4.8	3.1	4.2	-1.0	0.75
24	MOUNTAIN WAY S OF GARFIELD PL	210/200	250	8	7	210	0.38	0.54	04/13/82	0.67	0.21	0.46	1.35	0.34	2.04	3.80	3.4	57.7	0.20	1.18	2.0	1.3	1.8	-0.5	0.72
22	GARFIELD PL W OF MOUNTAIN WAY	202/200	375	8	7	210	0.57	0.73	04/12/82	0.67	0.21	0.46	1.51	0.30	1.83	2.51	3.0	64.1	0.20	1.17	2.0	1.3	2.7	-1.4	0.47
33	MOUNTAIN WAY S OF PIERREPONT	240/210	830	8	16	480	1.26	1.62	04/13/82	1.36	0.48	0.88	1.35	0.65	3.91	2.41	6.5	63.6	0.41	2.49	4.1	2.7	5.9	-3.2	0.45
41	WOODLAND AVE W OF MOUNTAIN WAY	280/260	575	8	19	570	0.87	1.30	04/13/82	1.03	0.57	0.46	1.35	0.34	2.04	1.57	3.4	54.8	0.19	1.12	1.9	1.2	4.1	-2.9	0.30
38	MOUNTAIN WAY S OF WOODLAND AVE	263/260	570	8	22	660	0.86	1.36	04/13/82	1.14	0.66	0.48	1.35	0.36	2.13	1.56	3.6	51.9	0.18	1.11	1.8	1.2	4.1	-2.9	0.29
11	MOUNTAIN WAY N OF WINSLOW PL	182/180	300	8	13	390	0.45	0.75	04/12/82	0.67	0.39	0.28	1.51	0.19	1.11	1.48	1.9	49.7	0.09	0.55	0.9	0.6	2.1	-1.5	0.28
27	VAN WINKLE PL S OF PIERREPONT	292/290	660	8	12	360	1.00	1.27	04/12/82	0.67	0.36	0.31	1.51	0.21	1.23	0.97	2.1	64.4	0.13	0.79	1.3	0.9	4.7	-3.9	0.18
2	EASTERN WAY N OF SUMMIT CROSS	112/110	380	8	15	450	0.58	0.92	04/12/82	0.67	0.45	0.22	1.51	0.15	0.87	0.95	1.5	51.5	0.08	0.45	0.8	0.5	2.7	-2.2	0.18
5	SUMMIT CROSS W OF FERONIA WAY	140/120	359	10	7	210	0.68	0.84	04/12/82	0.35	0.21	0.14	1.51	0.09	0.56	0.66	0.9	66.5	0.06	0.37	0.6	0.4	3.2	-2.8	0.12
13	WINSLOW & SYLVAN W OF PIERRPNT	*188/180	1090	8	26	780	1.65	2.24	04/12/82	1.14	0.78	0.36	1.51	0.24	1.43	0.64	2.4	60.4	0.14	0.86	1.4	0.9	7.8	-6.9	0.12

Continued on Sheet 2 of 2

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM N

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameter x Length			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																									
30	SYLVAN ST S OF PIERREPONT AVE	302/300	810	8	26	780	1.23	1.82	04/12/82	0.89	0.78	0.11	1.51	0.07	0.44	0.24	0.7	55.4	0.04	0.24	0.4	0.3	5.8	-5.5	0.05
26	PIERREPONT AVE W OF MOUNTAIN	300/210	495	8	9	270	0.75	0.95	04/12/82	0.25	0.25	0.00	1.51	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	3.5	-3.5	0.00
	17 SUBTOTAL NOT IN CONTRACT		8585		228	6840	13.46	18.64		16.06	6.82	9.24		6.44	38.60	2.07	64.4	59.8	3.85	23.14	38.5	25.2	63.4	-38.3	0.40
	20 TOTAL		9413		237	7110	14.71	20.10		19.79	7.09	12.70		8.81	52.81	2.63	88.1	62.8	5.53	33.27	55.3	36.2	69.4	-33.2	0.52

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM P

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
Reach	Street	Upper/Lower Manhole	Lateral + Trunk Length (ft)	Lateral + Trunk Diameter (in)	Building Connections Number	Building Connections Length(ft)	Diameterxlength <Ls> (1) (in-mi)	Diameterxlength <Lt> (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/ Cost Ratio
	SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																								
30	HIGHLAND CROSS AT SYLVAN ST	185/183	305	8	8	240	0.46	0.64	04/20/83	0.67	0.24	0.43	0.19	2.26	13.58	21.09	22.6	58.8	1.33	7.99	13.3	9.3	2.2	7.2	4.29
16	PASSAIC AVE E OF THE TERRACE	160/150	265	8	5	150	0.40	0.52	04/21/83	6.09	0.15	5.94	3.90	1.52	9.14	17.74	15.2	63.9	0.97	5.84	9.7	6.8	1.9	4.9	3.61
26	MOUNTAIN WAY S OF PASSAIC AVE	155/182	530	8	21	630	0.80	1.28	04/20/83	1.14	0.63	0.51	0.19	2.68	16.11	12.58	26.8	51.4	1.38	8.28	13.8	9.7	3.8	5.9	2.56
39	SUMMIT CROSS E OF MOUNTAIN WAY	240/220	385	8	5	150	0.58	0.70	04/20/83	1.14	0.15	0.99	0.69	1.43	8.61	12.35	14.3	68.6	0.98	5.91	9.8	6.9	2.8	4.2	2.51
43	SUMMIT CROSS W OF SYLVAN ST	244/240	189	8	2	60	0.29	0.33	04/20/83	0.49	0.06	0.43	0.69	0.62	3.74	11.27	6.2	70.8	0.44	2.65	4.4	3.1	1.4	1.7	2.29
32	ORIENT WAY AT SUMMIT CROSS	220/180	980	8	26	950	1.48	2.20	04/20/83	3.50	0.78	2.72	0.69	3.94	23.65	10.73	39.4	55.2	2.18	13.06	21.8	15.3	7.0	8.3	2.18
6	SPRINGDALE E OF ORIENT WAY	121/120	265	8	3	90	0.40	0.47	04/20/83	1.56	0.09	1.47	1.83	0.80	4.82	10.26	8.0	70.1	0.56	3.38	5.6	4.0	1.9	2.1	2.09
17	SYLVAN ST S OF PASSAIC AVE	163/160	555	8	12	360	0.84	1.11	04/21/83	6.09	0.36	5.73	3.90	1.47	8.82	7.92	14.7	61.9	0.91	5.46	9.1	6.4	4.0	2.4	1.61
	8 SUBTOTAL IN CONTRACT		3474		82	2630	5.25	7.25		20.68	2.46	18.22		14.72	88.47	12.20	147.2	59.4	8.75	52.57	87.5	61.5	25.0	36.7	2.46
	SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT																								
20	PASSAIC AVE E OF SYLVAN ST	164/160	165	8	5	150	0.25	0.36	04/21/83	1:70	0.15	1.55	3.90	0.40	2.38	6.56	4.0	56.4	0.22	1.34	2.2	1.6	1.2	0.4	1.33
3	GLEN ROAD E OF ORIENT WAY	112/110	480	8	18	540	0.73	1.14	04/20/83	2.50	0.54	1.96	1.83	1.07	6.43	5.66	10.7	52.5	0.56	3.37	5.6	3.9	3.4	0.5	1.15
14	THE TERRACE N OF PASSAIC AVE	152/150	415	8	8	360	0.63	0.90	04/21/83	3.50	0.24	3.26	3.90	0.84	5.02	5.56	8.4	57.2	0.48	2.87	4.8	3.4	3.0	0.4	1.13
22	ORIENT WAY S OF PASSAIC AVE	180/140	885	8	93	3720	1.34	4.16	04/20/83	18.22	1.70	16.52	4.80	3.44	20.65	4.97	34.4	26.4	0.91	5.46	9.1	6.4	6.3	0.1	1.01
21	SYLVAN ST N OF PASSAIC AVE	165/160	240	8	4	120	0.36	0.45	04/09/82	0.67	0.12	0.55	1.57	0.35	2.10	4.62	3.5	65.6	0.23	1.38	2.3	1.6	1.7	-0.1	0.94
41	SYLVAN ST N OF HIGHLAND CROSS	243/240	425	8	8	240	0.64	0.83	04/20/83	0.67	0.24	0.43	0.69	0.62	3.74	4.53	6.2	63.9	0.40	2.39	4.0	2.8	3.0	-0.2	0.92
36	MOUNTAIN WAY N OF SUMMIT CROSS	223/220	430	8	10	300	0.65	0.88	04/20/83	0.67	0.30	0.37	0.69	0.54	3.22	3.66	5.4	60.8	0.33	1.96	3.3	2.3	3.1	-0.8	0.74
12	PASSAIC AVE E OF ORIENT WAY	150/140	440	8	8	240	0.67	0.85	04/21/83	1.70	0.24	1.46	3.90	0.37	2.25	2.65	3.7	64.4	0.24	1.45	2.4	1.7	3.1	-1.5	0.54
10	ORIENT WAY S OF SPRINGDALE	140/120	625	8	41	1640	0.95	2.19	04/20/83	2.50	1.23	1.27	1.83	0.69	4.16	1.90	6.9	35.5	0.25	1.48	2.5	1.7	4.5	-2.7	0.39
2	ORIENT WAY AT GLEN ROAD	120/100	600	8	20	800	0.91	1.52	04/20/83	1.14	0.60	0.54	1.83	0.30	1.77	1.17	3.0	49.2	0.15	0.87	1.5	1.0	4.3	-3.3	0.24

Continued on Sheet 2 of 2

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

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9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

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RUTHERFORD MINISYSTEM P

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameterxlength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT Cont.																
7	SPRINGDALE E OF ETTRICK TERR	122/121	155	8	31	1650	0.23	1.48	04/20/83	0.14	0.14	0.00	1.83	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.1	-1.1	0.00
44	SYLVAN ST AT SUMMIT CROSS	241/240	160	8	6	180	0.24	0.38	04/20/83	0.14	0.14	0.00	0.69	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	1.1	-1.1	0.00
24	HIGHLAND CROSS E OF ORIENT WAY	183/180	585	8	11	330	0.89	1.14	04/20/83	0.22	0.22	0.00	0.19	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	4.2	-4.2	0.00
7A	SPRINGDALE AT ETTRICK TERR	125/121	300	8	52	1560	0.45	1.64	04/20/83	0.67	0.67	0.00	1.83	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	2.1	-2.1	0.00
	14 SUBTOTAL NOT IN CONTRACT		5905		315	11830	8.94	17.92		34.44	6.53	27.91		8.62	51.72	2.89	86.2	43.7	3.77	22.57	37.7	26.4	42.1	-15.7	0.63
	22 TOTAL		9379		397	14460	14.19	25.17		55.12	8.99	46.13		23.34	140.19	5.57	233.4	53.6	12.52	75.14	125.2	87.9	67.1	21.0	1.31

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for cost-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

JUNCTION METERING TO ADJUST NORMALIZED INFILTRATION RATE

IN MINISYSTEM P

JUNCTION LOCATION				JUNCTION FLOW MEASUREMENT					NORMALIZED AVERAGE INFILTRATION		
Junction Number	Street	From/Meas. MH No. (1)	Net Reaches Included (2)	Date	Net Flow (1000 gpd) (3)	Night Base (1000 gpd) (3)	Measured Infiltration (1000 gpd) (5)	Groundwater Index (6)	1983 Junction (7) (1000 gpd)	1980-82 Reach Sum (1000 gpd) (8)	Adjustment Ratio (9)
1	Orient Rd., Spring Pl. & Glen Pl.	110/100	2-11	4/20/83	18.62	4.74	13.88	4.8	2.89	3.34	0.86
2	Passaic Ave., W of Mountain Way	141/140	12, 13	4/21/83	1.70	0.24	1.46	3.9	0.37	0.27	1.37
3	The Terrace	151/150	14, 15	4/21/83	3.50	0.24	3.26	3.9	0.83	0.57	1.46
4	Passaic Ave., E of Mountain Way	160/150	16	4/21/83	6.09	0.15	5.94	3.9	1.52	0.27	5.63
5	Sylvan St., S of Passaic Ave.	161/160	17, 18, 19	4/21/83	6.09	0.36	5.73	3.9	1.46	0.20	7.30
6	Passaic Ave., W of Sylvan St.	164/160	20	4/21/83	1.70	0.15	1.55	3.9	0.39	0.27	1.44
7	Sylvan St., N of Passaic Ave.	165/160	21	4/9/82	0.67	0.12	0.55	1.57	0.35	0.35	-
8	Orient Way, S of Passaic Ave.	170/140	22, 23	4/20/83	18.22	2.79	15.43	4.8	3.21	0.00	-
9	Highland Cross & Mountain Way	181/180	24-31	4/20/83	24.52	1.20	23.32	4.8	4.85	0.59	8.22
10	Orient Way & Summit Cross	190/180	32-44	4/20/83	36.02	1.71	34.31	4.8	7.14	3.25	2.20
TOTAL									23.01	9.11	2.53

Notes:

(1) Manhole immediately upstream of junction/junction measurement manhole.

(2) See Table 3a-P for reach locations.

(3) Measured between 2 a.m. and 6 a.m. on indicated date.

(4) Night base flows = 0.225 average sanitary base at junctions; 0.30 average sanitary base at outlet.

(5) Measured infiltration = measured flow less night base flow.

(6) Groundwater Index = ratio of measured infiltration rate to average infiltration rate.

(7) Average infiltration = measured infiltration divided by Groundwater Index. (Total includes unadjusted reaches).

(8) The sum of normalized average infiltration calculated based on 1982 measurement.

(9) Ratio of normalized average infiltration rate based on 1983 junction metering to rate based on sum of flows isolated in included reaches in 1982. Each Groundwater Index in Tables 3a-P is the 1982 Groundwater Index divided by this ratio.

RUTHERFORD MINISYSTEM Q

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS				NORMALIZED INFILTRATION					POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameter x Length			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			(Ls) (1)	(Lt) (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																
52	RIDGE RD S OF SUMMIT CROSS	360/340	295	8	8	240	0.45	0.63	04/13/82	4.10	0.24	3.86	1.35	2.86	17.16	27.28	28.6	58.3	1.67	10.00	16.7	10.8	2.1	8.7	5.14
1	STATION AVE E OF PARK AVE	100/D170	275	8	18	720	0.42	0.96	04/12/82	5.40	0.54	4.86	1.51	3.22	19.31	20.07	32.2	35.5	1.14	6.86	11.4	7.4	2.0	5.5	3.78
54	RIDGE RD S OF ADDISON AVE	340/320	425	8	4	155	0.64	0.76	04/14/82	3.50	0.12	3.38	1.33	2.54	15.25	20.03	25.4	69.4	1.76	10.58	17.6	11.5	3.0	8.4	3.77
64	LINCOLN AVE S OF ADDISON AVE	384/381	240	8	3	90	0.36	0.43	04/13/82	1.70	0.09	1.61	1.35	1.19	7.16	16.57	11.9	69.1	0.82	4.94	8.2	5.4	1.7	3.6	3.12
21	PARK AVE S OF PASSAIC AVE	180/160	534	8	2	120	0.81	0.90	04/12/82	3.50	0.06	3.44	1.51	2.28	13.67	15.19	22.8	73.7	1.68	10.08	16.8	10.9	3.8	7.1	2.86
39	LINCOLN AVE W OF SUMMIT CROSS	374/162	489	8	15	710	0.74	1.28	04/13/82	4.70	0.45	4.25	1.35	3.15	18.89	14.77	31.5	47.5	1.50	8.97	15.0	9.7	3.5	6.2	2.78
4	STATION AVE W OF KIPP AVE	111/110	170	8	2	80	0.26	0.32	04/12/82	1.14	0.06	1.08	1.51	0.72	4.29	13.49	7.2	66.4	0.47	2.85	4.7	3.1	1.2	1.9	2.54
44	RIDGE RD & SUMMIT CROSS	374/360	810	8	14	420	1.23	1.55	04/13/82	4.70	0.42	4.28	1.35	3.17	19.02	12.31	31.7	65.1	2.06	12.39	20.6	13.4	5.8	7.6	2.32
2	STATION AVE W OF PARK AVE	110/100	500	8	12	480	0.76	1.12	04/12/82	3.50	0.36	3.14	1.51	2.08	12.48	11.13	20.8	55.4	1.15	6.91	11.5	7.5	3.6	3.9	2.10
60	LINCOLN AVE AT NEWELL AVE	381/374	540	8	6	180	0.82	0.95	04/13/82	2.50	0.18	2.32	1.35	1.72	10.31	10.80	17.2	70.3	1.21	7.25	12.1	7.8	3.9	4.0	2.03
36	LINCOLN AVE E OF PARK AVE	162/160	615	8	6	300	0.93	1.16	04/13/82	2.90	0.18	2.72	1.35	2.01	12.09	10.43	20.1	65.9	1.33	7.97	13.3	8.6	4.4	4.2	1.96
58	RIDGE RD S OF PIERREPONT AVE	324/322	335	8	11	330	0.51	0.76	04/14/82	1.70	0.33	1.37	1.33	1.03	6.18	8.16	10.3	54.9	0.57	3.40	5.7	3.7	2.4	1.3	1.54
25	PARK AVE S OF DONALDSON AVE	220/180	536	8	17	850	0.81	1.46	04/12/82	3.50	0.51	2.99	1.51	1.98	11.88	8.16	19.8	45.7	0.91	5.43	9.1	5.9	3.8	2.1	1.54
61	NEWELL AVE W OF LINCOLN AVE	380/378	560	8	14	420	0.85	1.17	04/13/82	2.50	0.42	2.08	1.35	1.54	9.24	7.92	15.4	59.6	0.92	5.51	9.2	6.0	4.0	2.0	1.49
5	KIPP AVE S OF STATION AVE	113/110	440	8	13	520	0.67	1.06	04/12/82	2.50	0.39	2.11	1.51	1.40	8.38	7.91	14.0	51.5	0.72	4.32	7.2	4.7	3.1	1.5	1.49
	15 SUBTOTAL IN CONTRACT		6764		145	5615	10.26	14.51		47.84	4.35	43.49		30.89	185.31	12.77	308.9	58.0	17.91	107.46	179.1	116.4	48.3	68.0	2.41
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																
49	RIDGE RD W OF SUMMIT CROSS	377/375	415	8	11	330	0.63	0.88	04/13/82	1.70	0.33	1.37	1.35	1.01	6.09	6.93	10.1	58.7	0.60	3.57	6.0	3.9	3.0	0.9	1.31
31	PARK AVE S OF WOODWARD AVE	224/220	317	8	11	550	0.48	0.90	04/13/82	1.70	0.33	1.37	1.35	1.01	6.09	6.79	10.1	43.9	0.45	2.67	4.5	2.9	2.3	0.6	1.28
38	HIGHLAND CROSS E OF LINCOLN AV	163/162	250	8	7	350	0.38	0.64	04/13/82	1.14	0.21	0.93	1.35	0.69	4.13	6.42	6.9	48.2	0.33	1.99	3.3	2.2	1.8	0.4	1.21

Continued on Sheet 2 of 2

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM Q

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		Diameter x Length			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
	SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																								
23	DONALDSON AVE W OF PARK AVE	182/180	427	8	8	450	0.65	0.99	04/12/82	1.70	0.24	1.46	1.51	0.97	5.80	5.87	9.7	53.7	0.52	3.12	5.2	3.4	3.1	0.3	1.11
41	WOODWARD AVE W OF LINCOLN AVE	167/165	488	8	10	500	0.74	1.12	04/13/82	1.70	0.30	1.40	1.35	1.04	6.22	5.56	10.4	54.2	0.56	3.37	5.6	3.7	3.5	0.2	1.05
34	NEWELL AVE W OF PARK AVE	226/224	188	8	11	660	0.28	0.78	04/13/82	1.14	0.33	0.81	1.35	0.60	3.60	4.59	6.0	29.8	0.18	1.07	1.8	1.2	1.3	-0.2	0.86
29	WOODWARD AVE W OF PARK AVE	222/220	535	8	16	800	0.81	1.42	04/13/82	1.70	0.48	1.22	1.35	0.90	5.42	3.83	9.0	46.9	0.42	2.54	4.2	2.8	3.8	-1.1	0.72
7	PARK AVE W OF SYLVAN ST	120/100	450	8	32	1280	0.68	1.65	04/12/82	2.50	0.96	1.54	1.51	1.02	6.12	3.71	10.2	33.9	0.35	2.07	3.5	2.2	3.2	-1.0	0.70
13	PARK AVE AT FAIRVIEW AVE	140/120	586	8	47	2340	0.89	2.66	04/12/82	3.50	1.41	2.09	1.51	1.38	8.30	3.12	13.8	27.4	0.38	2.27	3.8	2.5	4.2	-1.7	0.59
56	RIDGE RD E OF PIERREPONT AVE	322/320	400	8	11	330	0.61	0.86	04/14/82	0.80	0.33	0.47	1.33	0.35	2.12	2.48	3.5	58.1	0.21	1.23	2.1	1.3	2.9	-1.5	0.47
66	ADDISON AVE N OF LINCOLN AVE	382/381	410	8	11	330	0.62	0.87	04/13/82	0.67	0.33	0.34	1.35	0.25	1.51	1.73	2.5	58.5	0.15	0.88	1.5	1.0	2.9	-2.0	0.33
19	PARK AVE NE OF CHESTNUT ST	160/140	570	8	21	1260	0.86	1.82	04/12/82	1.20	0.63	0.57	1.51	0.38	2.26	1.25	3.8	39.0	0.15	0.88	1.5	1.0	4.1	-3.1	0.23
15	RIDGE RD AT PASSAIC AVE	143/140	898	8	24	960	1.36	2.09	04/12/82	1.14	0.72	0.42	1.51	0.28	1.67	0.80	2.8	53.4	0.15	0.89	1.5	1.0	6.4	-5.4	0.15
	13 SUBTOTAL NOT IN CONTRACT		5934		220	10140	8.99	16.68		20.59	6.60	13.99		9.88	59.33	3.56	98.8	45.0	4.45	26.55	44.5	29.1	42.5	-13.6	0.68
	28 TOTAL		12698		365	15755	19.25	31.19		68.43	10.95	57.48		40.77	244.64	7.84	407.7	54.8	22.36	134.01	223.6	145.5	90.8	54.4	1.60

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for cost-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM R

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
Reach	Street	Upper/Lower Manhole	Lateral + Trunk Length (ft)	Lateral + Trunk Diameter (in)	Building Connections Number	Building Connections Length(ft)	DiameterxLength <Ls> (1) (in-mi)	DiameterxLength <Lt> (2) (in-mi)	Date	Net Flow (3) (1000 gpd)	Night Base Flow (4) (1000 gpd)	Measured Infiltration(5) (1000 gpd)	Ground Water Index(6)	Average (7) (1000 gpd)	7-Day-Maximum (8) (1000gpd)	7-Day-Maximum (8) (1000gpd/Lt)	Peak(9) (1000gpd)	Percent	Average(10) (1000 gpd)	7-Day-Max(8) (1000 gpd)	Peak (9) (1000 gpd)	Benefit (11) ($1000)	Cost of CTAG (12) ($1000)	Net Benefit ($1000)	Benefit/ Cost Ratio
SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																									
58	WOOD ST N OF FAIRVIEW AVE	360/330	515	8	20	600	0.78	1.23	04/15/82	6.10	0.60	5.50	1.24	4.44	26.61	21.55	44.4	51.8	2.30	13.79	23.0	14.9	3.7	11.3	4.06
27	UNION AVE AT MAPLE ST	220/130	600	8	11	330	0.91	1.16	04/13/82	5.66	0.33	5.33	1.35	3.95	23.69	20.44	39.5	64.3	2.54	15.24	25.4	16.5	4.3	12.2	3.85
64	WOOD ST S OF UNION AVE	330/310	400	8	8	240	0.61	0.79	04/15/82	3.40	0.24	3.16	1.24	2.55	15.29	19.41	25.5	63.1	1.61	9.64	16.1	10.4	2.9	7.6	3.66
3	CHESTNUT ST S OF UNION AVE	122/120	910	8	17	510	1.38	1.77	04/13/82	7.80	0.51	7.29	1.35	5.40	32.40	18.36	54.0	64.1	3.46	20.75	34.6	22.5	6.5	16.0	3.46
10	UNION AVE N OF CHESTNUT ST	130/120	352	8	4	120	0.53	0.62	04/13/82	2.50	0.12	2.38	1.35	1.76	10.58	16.94	17.6	70.1	1.24	7.41	12.4	8.0	2.5	5.5	3.19
1	UNION AVE AT AGNEW PL	120/100	445	10	21	630	0.84	1.32	04/13/82	4.70	0.63	4.07	1.35	3.01	18.09	13.70	30.1	52.4	1.58	9.47	15.8	10.3	4.0	6.3	2.58
33	MORTIMER AVE S OF UNION AVE	240/220	420	8	16	480	0.64	1.00	04/14/82	3.50	0.48	3.02	1.33	2.27	13.62	13.62	22.7	52.2	1.18	7.11	11.8	7.7	3.0	4.7	2.57
73	UNION AVE W OF HACKETT PL	400/380	790	8	11	330	1.20	1.45	04/14/82	4.70	0.33	4.37	1.33	3.29	19.71	13.62	32.9	67.8	2.23	13.37	22.3	14.5	5.6	8.8	2.57
35	MORTIMER AVE N OF FAIRVIEW AVE	270/240	490	8	20	600	0.74	1.20	04/14/82	4.10	0.60	3.50	1.33	2.63	15.79	13.19	26.3	50.9	1.34	8.03	13.4	8.7	3.5	5.2	2.48
22	MORTIMER AVE & DONALDSON AVE	205/200	1233	8	25	750	1.87	2.44	04/13/82	7.60	0.75	6.85	1.35	5.07	30.44	12.50	50.7	62.9	3.19	19.14	31.9	20.7	8.8	11.9	2.35
4	STATION AVE W OF CHESTNUT ST	124/121	311	8	4	120	0.47	0.56	04/13/82	1.70	0.12	1.58	1.35	1.17	7.02	12.49	11.7	68.7	0.80	4.83	8.0	5.2	2.2	3.0	2.35
49	PASSAIC AVE AT WOOD ST	206/200	636	8	13	390	0.96	1.26	04/13/82	3.50	0.39	3.11	1.35	2.30	13.82	10.98	23.0	62.8	1.45	8.67	14.5	9.4	4.5	4.9	2.07
61	ESTATE ST W OF WOOD ST	331/330	255	8	2	60	0.39	0.43	04/15/82	1.03	0.06	0.97	1.24	0.78	4.69	10.87	7.8	73.4	0.57	3.44	5.7	3.7	1.8	1.9	2.05
53	FAIRVIEW AVE W OF WOOD ST	361/360	120	8	4	120	0.18	0.27	04/15/82	0.73	0.12	0.61	1.24	0.49	2.95	10.82	4.9	54.7	0.27	1.61	2.7	1.7	0.9	0.9	2.04
39	MORTIMER AVE S OF FAIRVIEW AVE	290/270	570	8	9	270	0.86	1.07	04/14/82	2.83	0.27	2.56	1.33	1.92	11.55	10.81	19.2	66.3	1.28	7.66	12.8	8.3	4.1	4.2	2.04
66	UNION AVE N OF WOOD ST	380/300	530	8	7	210	0.80	0.96	04/15/82	2.10	0.21	1.89	1.24	1.52	9.15	9.51	15.2	68.4	1.04	6.26	10.4	6.8	3.8	3.0	1.79
20	PASSAIC AVE S OF HOME AVE	200/180	600	8	10	300	0.91	1.14	04/13/82	2.60	0.30	2.30	1.35	1.70	10.22	9.00	17.0	65.6	1.12	6.71	11.2	7.3	4.3	3.0	1.69
15	ELLIOT PL W OF HOME AVE	173/170	540	8	4	120	0.82	0.91	04/14/82	1.70	0.12	1.58	1.33	1.19	7.13	7.84	11.9	73.8	0.88	5.26	8.8	5.7	3.9	1.8	1.48
62	HACKETT PL N OF STATION AVE	332/331	170	8	4	120	0.26	0.35	04/15/82	0.67	0.12	0.55	1.24	0.44	2.66	7.64	4.4	60.6	0.27	1.61	2.7	1.7	1.2	0.5	1.44
	19 SUBTOTAL IN CONTRACT		9887		210	6300	15.15	19.93		66.92	6.30	60.62		45.88	275.41	13.82	458.8	61.8	28.35	170.00	283.5	184.0	71.5	112.7	2.57

Continued on Sheet 2 of 3

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM R

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		DiameterxLength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																
11	HOME AVE AT STATION AVE	150/130	689	8	10	300	1.04	1.27	04/14/82	2.20	0.30	1.90	1.33	1.43	8.57	6.74	14.3	67.3	0.96	5.77	9.6	6.3	4.9	1.3	1.27
51	WOOD ST N OF ELLIOT PL	371/360	575	8	8	240	0.87	1.05	04/15/82	1.70	0.24	1.46	1.24	1.18	7.06	6.71	11.8	67.8	0.80	4.79	8.0	5.2	4.1	1.1	1.26
47	ELLIOT PL W OF WOOD ST	374/371	470	8	3	90	0.71	0.78	04/15/82	1.14	0.09	1.05	1.24	0.85	5.08	6.51	8.5	74.8	0.63	3.80	6.3	4.1	3.4	0.8	1.23
67	UNION AVE E OF IRVING PL	300/220	295	8	8	240	0.45	0.63	04/14/82	1.14	0.24	0.90	1.33	0.68	4.06	6.46	6.8	58.3	0.39	2.37	3.9	2.6	2.1	0.5	1.22
54	FAIRVIEW AVE W OF HACKETT PL	364/361	360	8	5	150	0.55	0.66	04/15/82	0.97	0.15	0.82	1.24	0.66	3.97	6.02	6.6	67.9	0.45	2.69	4.5	2.9	2.6	0.3	1.13
28	MAPLE ST S OF UNION AVE	212/210	320	8	12	360	0.48	0.76	04/13/82	1.36	0.36	1.00	1.35	0.74	4.44	5.87	7.4	52.5	0.39	2.33	3.9	2.5	2.3	0.2	1.10
7	CHESTNUT ST S OF FAIRVIEW AVE	123/122	550	8	10	300	0.83	1.06	04/13/82	1.70	0.30	1.40	1.35	1.04	6.22	5.87	10.4	64.4	0.67	4.01	6.7	4.3	3.9	0.4	1.10
18	HOME AVE S OF ELLIOT PL	180/170	340	8	4	120	0.52	0.61	04/14/82	0.79	0.12	0.67	1.33	0.50	3.02	4.99	5.0	69.7	0.35	2.11	3.5	2.3	2.4	-0.1	0.94
63	HACKETT PL S OF STAION AVE	333/331	335	8	12	360	0.51	0.78	04/15/82	1.14	0.36	0.78	1.24	0.63	3.77	4.84	6.3	53.3	0.34	2.01	3.4	2.2	2.4	-0.2	0.91
13	HOME AVE AT FAIRVIEW AVE	170/150	770	8	25	760	1.17	1.74	04/14/82	2.50	0.75	1.75	1.33	1.32	7.89	4.53	13.2	54.9	0.72	4.33	7.2	4.7	5.5	-0.8	0.85
8	FARIVEW AVE E OF CHESTNUT ST	127/122	395	8	10	300	0.60	0.83	04/13/82	1.14	0.30	0.84	1.35	0.62	3.73	4.52	6.2	59.4	0.37	2.22	3.7	2.4	2.8	-0.4	0.85
57	MILTON PL S OF FAIRVIEW AVE	365/361	180	8	2	60	0.27	0.32	04/15/82	0.35	0.06	0.29	1.24	0.23	1.40	4.41	2.3	70.3	0.16	0.99	1.6	1.1	1.3	-0.2	0.83
77	PROSPECT PL S OF UNION AVE	402/400	310	8	14	420	0.47	0.79	04/14/82	1.14	0.42	0.72	1.33	0.54	3.25	4.12	5.4	48.9	0.26	1.59	2.6	1.7	2.2	-0.5	0.78
74	MONTROSE AVE S OF UNION AVE	392/390	645	8	18	540	0.98	1.39	04/14/82	1.70	0.54	1.16	1.33	0.87	5.23	3.77	8.7	57.8	0.50	3.02	5.0	3.3	4.6	-1.3	0.71
42	ELLIOT PL W OF MORTIMER AVE	293/290	280	8	9	270	0.42	0.63	04/14/82	0.79	0.27	0.52	1.33	0.39	2.35	3.73	3.9	55.3	0.22	1.30	2.2	1.4	2.0	-0.6	0.70
41	MORTIMER AVE S OF ELLIOT PL	291/290	300	8	8	240	0.45	0.64	04/14/82	0.67	0.24	0.43	1.33	0.32	1.94	3.05	3.2	58.6	0.19	1.14	1.9	1.2	2.1	-0.9	0.57
45	ELLIOT PL W OF IRVING PL	293/371	300	8	11	360	0.45	0.73	04/15/82	0.67	0.33	0.34	1.24	0.27	1.65	2.26	2.7	51.3	0.14	0.84	1.4	0.9	2.1	-1.2	0.43
30	MAPLE ST S OF UNION AVE	214/212	447	8	21	630	0.68	1.15	04/13/82	1.14	0.63	0.51	1.35	0.38	2.27	1.96	3.8	48.1	0.18	1.09	1.8	1.2	3.2	-2.0	0.37
44	IRVING PL N OF ELLIOT PL	294/293	170	8	6	180	0.26	0.39	04/14/82	0.35	0.18	0.17	1.33	0.13	0.77	1.95	1.3	53.6	0.07	0.41	0.7	0.4	1.2	-0.8	0.37
68	IRVING PL S OF UNION AVE	302/300	550	8	19	570	0.83	1.27	04/14/82	1.03	0.57	0.46	1.33	0.35	2.08	1.64	3.5	54.0	0.19	1.12	1.9	1.2	3.9	-2.7	0.31

Continued on Sheet 3 of 3

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.
2) Includes building connections.
3) Measured between 2 a.m. and 6 a.m. on indicated date.
4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.
5) Measured infiltration = measured flow - night base flow.
6) Ground water index = ratio of measured infiltration rate to average infiltration rate.
7) Average infiltration = measured infiltration divided by ground water index.
8) The 7-day-max. infiltration = 6 x average infiltration.
9) Peak infiltration = 10 x average infiltration.
10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.
11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.
12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.
13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.
14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM R

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION					POSSIBLE INFILTRATION REDUCTION			COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		DiameterxLength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
									SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14) Cont.																
19	PASSAIC AVE E OF HOME AVE	181/180	335	8	6	180	0.51	0.64	04/14/82	0.35	0.18	0.17	1.33	0.13	0.77	1.19	1.3	64.6	0.08	0.50	0.8	0.5	2.4	-1.9	0.22
70	IRVING PL W OF FAIRVIEW AVE	304/302	460	8	16	480	0.70	1.06	04/14/82	0.67	0.48	0.19	1.33	0.14	0.86	0.81	1.4	53.9	0.08	0.46	0.8	0.5	3.3	-2.8	0.15
38	FAIRVIEW AVE W OF MORTIMER AVE	271/270	130	8	4	120	0.20	0.29	04/14/82	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.0	0.0	0.00	0.00	0.0	0.0	0.9	-0.9	0.00
	23 SUBTOTAL NOT IN CONTRACT		9206		241	7270	13.95	19.47		24.64	7.11	17.53		13.40	80.38	4.13	134.0	60.8	8.14	48.89	81.4	52.9	65.6	-12.7	0.81
	42 TOTAL		19093		451	13570	29.10	39.40		91.56	13.41	78.15		59.28	355.79	9.03	592.8	95.8	36.49	218.89	364.9	236.9	137.1	100.0	1.72

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

RUTHERFORD MINISYSTEM U

FLOW ISOLATION SUMMARY AND TEST AND SEAL RECOMMENDATIONS

REACH LOCATION			SEWER REACH DIMENSIONS						ISOLATED FLOW MEASUREMENTS					NORMALIZED INFILTRATION				POSSIBLE INFILTRATION REDUCTION				COST EFFECTIVENESS			
		Upper/Lower	Lateral + Trunk		Building Connections		DiameterxLength			Net Flow	Night Base	Measured	Ground	Average (7)	7-Day-Maximum (8)		Peak(9)		Average(10)	7-Day-Max(8)	Peak (9)	Benefit (11)	Cost of	Net	Benefit/
			Length	Diameter			<Ls> (1)	<Lt> (2)		(3)	Flow (4)	Infiltration(5)	Water										CTAG (12)	Benefit	Cost
Reach	Street	Manhole	(ft)	(in)	Number	Length(ft)	(in-mi)	(in-mi)	Date	(1000 gpd)	(1000 gpd)	(1000 gpd)	Index(6)	(1000 gpd)	(1000gpd)	(1000gpd/Lt)	(1000gpd)	Percent	(1000 gpd)	(1000 gpd)	(1000 gpd)	($1000)	($1000)	($1000)	Ratio
	SEWERS RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (13)																								
9	VETERANS BLVD (CENTRAL PART)	171/170	261	18	2	200	0.89	1.04	05/06/82	1.70	0.06	1.64	0.86	1.91	11.44	10.99	19.1	70.1	1.34	8.02	13.4	9.4	4.2	5.2	2.24
13	VETERANS BLVD (SOUTHERN PART)	220/200	355	18	2	200	1.21	1.36	05/06/82	1.70	0.06	1.64	0.86	1.91	11.44	8.40	19.1	72.9	1.39	8.34	13.9	9.8	5.7	4.0	1.71
	2 SUBTOTAL IN CONTRACT		616		4	400	2.10	2.40		3.40	0.12	3.28		3.82	22.88	9.53	38.2	71.5	2.73	16.36	27.3	19.2	9.9	9.2	1.94
	SEWERS NOT RECOMMENDED FOR INCLUSION IN TEST AND SEAL CONTRACT (14)																								
4	VETERANS BLVD S OF BOROUGH ST	150/120	637	18	1	300	2.17	2.40	05/06/82	2.50	0.03	2.47	0.86	2.87	17.23	7.18	28.7	74.2	2.13	12.79	21.3	15.0	10.2	4.7	1.46
10	VETERANS BLVD (SOUTHERN PART)	200/170	502	18	3	300	1.71	1.94	05/06/82	1.70	0.09	1.61	0.86	1.87	11.23	5.79	18.7	72.4	1.36	8.13	13.6	9.5	8.1	1.4	1.18
16	VETERANS BLVD (SOUTHERN PART)	202/200	402	15	2	250	1.14	1.33	05/06/82	1.14	0.06	1.08	0.86	1.26	7.53	5.66	12.6	70.3	0.88	5.30	8.8	6.2	5.4	0.8	1.15
1	VETERANS BLVD S OF BOROUGH ST	120/UM120	614	18	0	0	2.09	2.09	05/06/82	1.00	0.00	1.00	0.86	1.16	6.98	3.33	11.6	82.0	0.95	5.72	9.5	6.7	9.9	-3.2	0.68
7	VETERANS BLVD (CENTRAL PART)	170/150	501	18	2	250	1.71	1.90	05/06/82	0.80	0.06	0.74	0.86	0.86	5.16	2.72	8.6	73.8	0.64	3.81	6.4	4.5	8.1	-3.6	0.55
	5 SUBTOTAL NOT IN CONTRACT		2656		8	1100	8.82	9.66		7.14	0.24	6.90		8.02	48.13	4.98	80.2	74.3	5.96	35.75	59.6	41.9	41.7	0.1	1.00
	7 TOTAL		3272		12	1500	10.92	12.06		10.54	0.36	10.18		11.84	71.01	5.89	118.4	73.4	8.69	52.11	86.9	61.1	51.6	9.3	1.18

FOOTNOTES FOR RERC JOINT MEETING

1) Excludes building connections.

2) Includes building connections.

3) Measured between 2 a.m. and 6 a.m. on indicated date.

4) Night base flow = 0.15 x annual metered water consumption, or 30 gpd/d.u.

5) Measured infiltration = measured flow - night base flow.

6) Ground water index = ratio of measured infiltration rate to average infiltration rate.

7) Average infiltration = measured infiltration divided by ground water index.

8) The 7-day-max. infiltration = 6 x average infiltration.

9) Peak infiltration = 10 x average infiltration.

10) Estimated infiltration reduction by CTAG = 0.82 x present infiltration x Ls/Lt.

11) Benefit ($1000) = 1.167 x 7-day-max. infiltration reduction (1000 gpd). Represents 1981 savings from reduced treatment and transport capacity requirements and cost savings from reduced O & M costs.

12) Cost of the Clean-Televise-Airtest-Grout (CTAG) rehabilitation procedure ($1000) = 4.715 x Ls; based on 1981 CTAG cost of $4715 per inch mile.

13) Sewers with 7-day-max. infiltration (1000 gpd/Lt) exceeding 7.400 which is 1.5 times 4930 gpd/in-mi, for csot-effective CTAG.

14) Sewers with 7-day-max. infiltration (1000 gpd/Lt) less than 7.400

JUNCTION METERING TO ADJUST NORMALIZED INFILTRATION RATE

IN MINISYSTEM U

JUNCTION LOCATION				JUNCTION FLOW MEASUREMENT					NORMALIZED AVERAGE INFILTRATION		
Junction Number	Street	From/Meas. MH No. (1)	Net Reaches Included (2)	Date	Net Flow (1000 gpd) (3)	Night Base (1000 gpd) (3)	Measured Infiltration (1000 gpd) (5)	Groundwater Index (6)	1983 Junction (7) (1000 gpd)	1980-82 Reach Sum (1000 gpd) (8)	Adjustment Ratio (9)
Outlet	Borough St. @ Veterans Blvd.	100/UM-120	All	5/6/83	13.85	0.36	13.49	1.14	11.83	6.48	1.83

Notes:

(1) Manhole immediately upstream of junction/junction measurement manhole.

(2) See Table 3a-U for reach locations.

(3) Measured between 2 a.m. and 6 a.m. on indicated date.

(4) Night base flows = 0.225 average sanitary base at junctions; 0.30 average sanitary base at outlet.

(5) Measured infiltration = measured flow less night base flow.

(6) Groundwater Index = ratio of measured infiltration rate to average infiltration rate.

(7) Average infiltration = measured infiltration divided by Groundwater Index.

(8) The sum of normalized average infiltration calculated based on 1982 measurement.

(9) Ratio of normalized average infiltration rate based on 1983 junction metering to rate based on sum of flows isolated in included reaches in 1982. Each Groundwater Index in Table 3a-U is the 1982 Groundwater Index divided by this ratio.

RERC JOINT MEETING

TEST-AND-SEAL PROGRAM TO REDUCE INDIRECT INFLOW

RERC-JM Borough	Mini-system	Reach	Location	Reach Limits Lower MH	Reach Limits Upper MH	Dimensions Length (ft)	Dimensions Diameter (inch)	Ls (1) (in-mi)	Area Flooded	Flow Reduction (1000 gpd) Avg (2)	Flow Reduction (1000 gpd) Peak (3)	Benefit of Reduction ($1000) (4)	Cost of Test-and-Seal ($1000) (5)	Benefit/ Cost Ratio
Carlstadt	A	18	Broad St. E of Twentieth St.	145	146	112	12	0.26	(7)	(6)	(6)	(6)	(6)	
	A	18	Broad St. E of Twentieth St.	146	147	300	12	0.68	(7)	(6)	(6)	(6)	(6)	
Subtotals						412		0.94						
E. Rutherford	L	2	Central Ave. @ Oak St.	330	337	150	8	0.23	(7)	0.09	2.76	1.78	1.08	1.65
	L	3	Central Ave. @ Oak St.	330	331	200	8	0.30	(7)	0.12	3.60	2.38	1.41	1.69
Subtotals						350		0.53		0.21	6.36	4.16	2.49	1.67
Rutherford	M	67	Pierrepont Ave. at Orient Way	290	294	315	8	0.48	(7)	0.19	5.76	3.76	2.26	1.66
	P	12	Passaic Ave. W of Mountain Way	140	150	440	8	0.67	(7)	0.27	8.10	5.35	3.16	1.69
	P	22(PT)	Orient Way N of Highland Cross	170	180	450	8	0.68	(7)	0.27	8.16	5.35	3.21	1.67
	P	36(PT)	Mountain Way N of Summit Cross	222	223	200	8	0.32	(7)	0.13	3.84	2.57	1.51	1.70
	R	11	Union Ave. @ Home Ave.	130	150	689	8	1.00	(7)	0.40	12.00	7.92	4.72	1.68
	S	1	Maple St. @ Washington Ave.	120	140	400	8	0.61	(8)	0.24	7.20	4.75	2.88	1.65
	U	7(PT)	Veterans Blvd. N of Armack Rd.	160	170	147	18	0.84	(8)	0.34	10.08	6.73	3.96	1.70
Subtotals						2641		4.60		1.84	55.14	36.43	21.70	1.68
RERC-JM TOTALS						3403		6.07		2.05	61.50	40.59	24.19	1.68

Notes:

(1) Ls = diameter - length of trunk and lateral sewers for test-and-seal program.
(2) Annual average flow reduction = 410 gpd/Ls.
(3) Coincident peak flow reduction = 30 x average flow reduction
(4) Benefit of reduction based on 1981 estimate = $19.8/avg. gpd reduced, based on ($0.64 x peak gpd x 30 avg./peak) + (0.60 x avg. gpd).
(5) Cost of test-and-seal based on 1981 estimate = $4715/Ls. See Table 1b for 1984 estimate.
(6) Entire reach included in test-and-seal program to reduce infiltration. See Table 1a-A.
(7) Parallel storm sewer.
(8) Hole in ground where smoke was observed.

RERC JOINT MEETING - CARLSTADT

DATA ON REACHES AND MANHOLES IN
RECOMMENDED TEST-AND-SEAL CONTRACT

			REACH DATA							MANHOLE DATA (Upper MH/Lower MH)				
			Limits										Sedimentation	
Mini-system	Reach	Location	Lower MH	Upper MH	Length (ft)	Diameter (inch)	Type Pipe	Approximate No. of Jts.		Depth (1)	Rungs (2)	Approximate Flow (3)	Depth (4)	Type (5)
					MINISYSTEM A									
A	1	Sixteenth St., N of Broad St.	100	102	410	12	VCP	137		A/A	A/A	A/A	B/C	F/F
A	3	Sixteenth St., N of Broad St.	102	105	605	12	VCP	202		A/A	A/A	A/A	A/A	A/A
A	6	Broad St., E of Sixteenth St.	100	130	680	18	VCP	227		B/B	A/A	A/A	A/A	A/A
A	11	Broad St., E of Eighteenth St.	130	142	947	12	VCP	316		A/A	A/A	A/A	A/A	A/A
A	15	Broad St., E of Twentieth St.	142	145	538	12	VCP	179		A/A	C/A	A/A	A/A	A/A
A	18	Broad St., E of Twentieth St.**	145	147	412	12	VCP	137		B/B	A/A	A/A	A/A	A/A
Subtotals - Minisystem A					3592			1198						
					MINISYSTEM B									
B	2	Broad St., E of Twelfth St.	110	140	498	18	VCP	166		B/B	A/A	B/B	A/A	A/A
B	5	N Side Broad St., W of Fifteenth St.	140	151	272	8	VCP	91		B/B	A/A	C/C	C/C	B/B
B	6	Fourteenth St., S of Broad St.	150	161	310	8	VCP	103		B/B	A/A	A/C	A/C	A/B
B	8	S Side Broad St., W of Sixteenth St.	160	163	450	8	VCP	150		A/A	A/A	A/A	C/A	C/A
B	47	N Side Broad St. @ Route 17	142	400	250	12	VCP	83		B/B	A/A	A/A	A/A	A/A
B	51	Thirteenth St., N of Broad St.	130	397	775	8	VCP	258		A/A	A/A	B/B	A/A	A/A
B	87	Eighth St., N of Passaic Ave.	433	434	233	8	VCP	78		B/B	A/A	A/A	A/A	A/A
Subtotals - Minisystem B					2788			929						

*Reach is included only in indirect inflow reduction phase.
**Reach is included in both I/I reduction phases.

Continued on Sheet 2 of 2

(1) Manhole Depth	(2) Rung Condition	(3) Flow Depth	Sedimentation (4) Depth	Sedimentation (5) Type
A. 0-8 ft	A. Sound	A. 0-1/4 Pipe	A. None	A. None
B. 8-12 ft	B. Unusable	B. 1/4-1/2 Pipe	B. Negl.- 1 in	B. Sludge
C. 12-20 ft	C. None	C. 1/2 Pipe+	C. 1-3 in	C. Soil
D. 20 ft+			D. 3 in +	D. Grease
				E. Detergent
				F. Debris
				G. Paper

Note: The data is based on manhole inspections completed in 1982.

RERC JOINT MEETING - CARLSTADT

DATA ON REACHES AND MANHOLES IN
RECOMMENDED TEST-AND-SEAL CONTRACT

			REACH DATA						MANHOLE DATA (Upper MH/Lower MH)				
			Limits									Sedimentation	
Mini-system	Reach	Location	Lower MH	Upper MH	Length (ft)	Diameter (inch)	Type Pipe	Approximate No. of Jts.	Depth (1)	Rungs (2)	Approximate Flow (3)	Depth (4)	Type (5)
					MINISYSTEM D								
D	1	Sixth St. @ Broad St.	100	130	105	8	VCP	35	A/B	A/A	B/B	A/A	A/A
D	10	Division St., W of Fifth St.	152	153	162	8	VCP	54	A/A	A/A	A/A	A/A	A/A
D	11	Fifth St., N of Division St.	152	154	264	8	VCP	88	A/A	A/A	A/A	A/A	A/A
D	18	Central Ave., W of Hackensack Ave.	164	165	379	8	VCP	126	A/A	A/A	A/A	A/A	A/A
D	23	Fourth St., N of Broad St. St.	170	171	298	8	VCP	99	A/A	A/A	A/A	A/A	A/A
D	31	Third St., N of Summit Ave.t.	185	186	291	8	VCP	97	A/A	A/A	A/A	A/A	A/A
D	31A	Summit Ave., N of Passaic Ave.	290	300	585	8	VCP	195	A/A	A/A	A/A	A/A	A/A
D	42	Division St., W of First St.	220	221	270	8	VCP	90	A/A	A/A	A/A	A/A	A/A
D	44	Central Ave., E of First St.	230	231	191	8	VCP	64	/A	/A	/A	/A	/A
D	49	First St., N of Summit Ave.	234	236	225	8	VCP	75	A/A	A/A	A/A	A/A	A/A
D	76	Hill St., S of Center St.	295	297	435	8	VCP	145	A/A	A/A	A/A	A/A	A/A
Subtotals - Minisystem D					3205			1068					
					MINISYSTEM F								
F	2	Poplar St., S of Paterson Ave.	100	120	554	12	VCP	185	A/A	A/A	B/B	B/B	B/B
F	4	Paterson Ave., W of Garden St.	120	121	272	8	VCP	91	A/A	A/A	A/B	A/B	A/B
F	5	Paterson Ave. @ Garden St.	120	140	110	8	VCP	37	/A	/A	/B	/B	/B
F	6	Paterson Ave. @ Hoboken Rd.	120	125	625	8	VCP	208	A/A	A/A	B/A	B/A	B/A
F	11	N Side Hoboken Rd., E of Paterson	140	141	365	8	VCP	122	A/A	A/A	A/A	A/A	A/A
F	12	N Side Hoboken Rd., E of Paterson	141	142	225	8	VCP	75	A/A	A/A	A/A	A/A	A/A
F	13	Lincoln St., E of Hoboken Rd.	141	144	407	8	VCP	136	A/A	A/A	A/A	A/A	A/A
F	15	Garden St., N of Hoboken Rd.	140	160	580	8	VCP	193	A/A	A/A	A/A	A/A	A/A
F	18	Garden St., N of Broad St.	160	230	660	8	VCP	220	A/A	A/A	B/B	A/A	A/A
F	19	Broad St. @ Orchard St.	160	170	227	8	VCP	76	A/A	A/A	A/A	A/A	A/A
F	21	Broad St., E of Orchard St.	170	180	195	8	VCP	65	A/A	A/A	A/A	A/A	A/A
F	23	Lincoln St., N of Broad St.	180	210	945	8	VCP	315	A/A	A/A	A/A	A/A	A/A
F	26	Central Ave., E of Lincoln St.	210	211	202	8	VCP	67	/A	/A	/A	/B	/B
F	28	Central Ave., N of Lincoln St.	210	213	229	8	VCP	76	A/A	A/A	A/A	B/A	B/A
F	29	Central Ave. @ Interstate Pl.	213	215	259	8	VCP	86	/A	/A	/A	/A	/A
F	30	Interstate Pl., N of Central Ave.	213	214	282	8	VCP	94	/A	/A	/A	/B	/B
F	31	Orchard St., N of Broad St.	170	171	333	6	VCP	111	A/A	A/A	A/A	A/A	A/A
F	32	Orchard St., S of Division St.	231	171	318	8	VCP	106	A/A	A/A	A/A	A/A	A/A
F	38	Garden St., S of Carlyle St.	250	280	664	8	VCP	221	A/A	A/A	A/A	B/C	F/F
F	51	Industrial Ave., N of Pump Sta.	898	901	455	8	VCP	152	D/D	A/A	B/B	A/A	A/A
F	54	Industrial Ave.	901	903	367	8	VCP	122	D/D	A/A	B/B	A/A	A/A
F	56	Industrial Ave., N of Pump Sta.	903	906	611	8	VCP	204	D/D	A/A	B/B	A/A	A/A
F	59	Industrial Ave., N of Pump Sta.	906	909	549	8	VCP	183	D/D	A/A	B/B	A/A	A/A
Subtotals - Minisystem F					9434			3145					
TOTALS - CARLSTADT					19019			6340					

TABLE 3c

RERC JOINT MEETING

RECOMMENDED TEST-AND-SEAL CONTRACT QUANTITIES

Item Number (1)	Description	Units	Estimated Quantities: Carlstadt	East Rutherford	Rutherford	RERC-JM Totals
1	Cleaning of Sanitary Sewers with the Following Diameters:					
A	6 inch	Linear Feet	300	0	0	300
B	8 inch		13400	5300	27400	46100
C	10 inch		0	0	400	400
D	12 inch		3700	0	800	4500
E	15 inch		0	800	0	800
F	18 inch		1200	2000	300	3500
2	Television Inspection of Sanitary Sewers with the Following Diameters:					
A	6 inch	Linear Feet	300	0	0	300
B	8 inch		13400	5300	27400	46100
C	10 inch		0	0	400	400
D	12 inch		3700	0	800	4500
E	15 inch		0	800	0	800
F	18 inch		1200	2000	300	3500
3	Pressure Testing the Joints of Sanitary Sewers with the Following Diameters:					
A	6 inch	Joints Tested	100	0	0	100
B	8 inch		4500	1800	9000	15300
C	10 inch		0	0	100	100
D	12 inch		1500	0	300	1800
E	15 inch		0	300	0	300
F	18 inch		400	700	100	1200
4	Chemical Grouting the Joints of Sanitary Sewers with the Following Diameters:					
A	6 inch	Joints Grouted	100	0	0	100
B	8 inch		1500	600	3000	5100
C	10 inch		0	0	100	100
D	12 inch		500	0	100	600
E	15 inch		0	100	0	100
F	18 inch		100	200	100	400

(1) For compatible test-and-seal contract, see BCUA Contract 96.

RERC JOINT MEETING - RUTHERFORD

DATA ON REACHES AND MANHOLES IN
RECOMMENDED TEST-AND-SEAL CONTRACT

Mini-system	Reach	Location	REACH DATA Limits Lower MH	Upper MH	Length (ft)	Diameter (inch)	Type Pipe	Approximate No. of Jts.	MANHOLE DATA (Upper MH/Lower MH) Depth (1)	Rungs (2)	Approximate Flow (3)	Sedimentation Depth (4)	Type (5)
					MINISYSTEM M								
M	1	Route 17, N of Pierrepont Ave.	100	140	756	12	VCP	252	A/A	A/A	A/A	A/A	A/A
M	12	Crane Ave. @ Route 17	140	270	1593	8	VCP	531	A/A	A/A	A/A	A/A	A/A
M	26	Pierrepont Ave., W of Route 17	150	190	253	8	VCP	84	A/A	A/A	A/A	A/A	A/A
M	33	Feronia Way, S of Summit Cross	200	204	782	8	VCP	261	A/A	A/A	A/A	A/A	A/A
M	43	Feronia Way @ Nevins St.	250	240	345	8	VCP	115	A/A	A/A	A/A	A/A	A/A
M	40	Nevins St., W of Feronia Way	230	231	296	8	VCP	99	A/A	A/A	A/A	A/A	A/A
M	41	Nevins St., E of Feronia Way	240	241	289	8	VCP	96	A/A	A/A	A/A	A/A	A/A
M	44	Crane Ave., W of Feronia Way	250	251	198	8	VCP	66	A/A	A/A	A/A	A/A	A/A
M	47A	Feronia Way, S of Van Riper Ave.	253	255	125	8	VCP	42	A/A	A/A	A/A	A/A	A/A
M	48	Crane Ave., E of Feronia Ave.	260	250	329	8	VCP	110	A/A	A/A	A/A	A/A	A/A
M	56	Arthur Dr., E of Crane Ave.	270	273	288	8	VCP	96	A/A	A/A	A/A	A/A	A/A
M	62	Pierrepont Ave., W of Feronia Way	200	290	341	8	VCP	114	A/A	A/A	A/A	A/A	A/A
M	64	Orient Way, N of Pierrepont Ave.	290	292	477	8	VCP	159	A/A	A/A	A/A	A/A	A/A
M	67	Pierrepont Ave., W of Orient Way*	290	294	315	8	VCP	105	A/A	A/A	A/A	A/A	A/B
M	68	Orient Way, S of Pierrepont Ave.	290	320	905	8	VCP	302	A/A	A/A	A/A	A/A	A/A
M	81	Orient Way, E of Van Riper Ave.	340	350	256	8	VCP	85	A/A	A/A	A/A	A/A	A/A
M	85	Barrows Ave., W of Orient Way	350	352	386	8	VCP	129	A/A	A/A	A/A	A/A	A/A
Subtotals - Minisystem M					7934			2646					
					MINISYSTEM N								
N	10	Winslow Pl., W of Orient Way	160	180	385	8	VCP	128	B/A	A/A	A/A	A/A	A/A
N	32	Pierrepont Ave., W of Sylvan St.	300	310	210	8	VCP	70	A/B	A/A	A/A	A/A	A/A
N	36	Mountain Way, N of Woodland Ave.	240	260	233	8	VCP	78	B/B	A/A	A/A	A/A	A/A
Subtotals - Minisystem N					828			276					

Continued on Sheet 2 of 3

*Reach is included only in indirect inflow reduction phase.

(1) Manhole Depth
- A. 0-8 ft
- B. 8-12 ft
- C. 12-20 ft
- D. 20 ft+

(2) Rung Condition
- A. Sound
- B. Unusable
- C. None

(3) Flow Depth
- A. 0-1/4 Pipe
- B. 1/4-1/2 Pipe
- C. 1/2 Pipe+

Sedimentation

(4) Depth
- A. None
- B. Negl.- 1 in.
- C. 1-3 in.
- D. 3 in.+

(5) Type
- A. None
- B. Sludge
- C. Soil
- D. Grease
- E. Detergent
- F. Debris
- G. Paper

Note: The data is based on manhole inspections completed in 1982.

RERC JOINT MEETING - EAST RUTHERFORD

DATA ON REACHES AND MANHOLES IN RECOMMENDED TEST-AND-SEAL CONTRACT

			REACH DATA						MANHOLE DATA (Upper MH/Lower MH)				
			Limits									Sedimentation	
Mini-system	Reach	Location	Lower MH	Upper MH	Length (ft)	Diameter (inch)	Type Pipe	Approximate No. of Jts.	Depth (1)	Rungs (2)	Approximate Flow (3)	Depth (4)	Type (5)
					MINISYSTEM J								
J	1	Union Ave., E of Van Winkle St.	100	120	500	18	VCP	167	B/B	B/A	A/A	C/A	F/A
J	2	Summer St., N of Union Ave.	110	111	430	8	VCP	143	B/A	A/A	A/A	A/A	A/A
J	5	Union Ave., E of Park Ave.	120	130	320	18	VCP	107	B/B	A/A	A/A	A/C	A/F
J	6	Park Ave., N of Union Ave.	130	131	461	8	VCP	154	A/B	A/A	A/A	A/A	A/A
J	8	Railroad Ave., W of Park Ave.	130	150	410	18	VCP	137	B/B	A/A	A/A	A/A	A/A
J	10	Boiling Spr., N of Railroad Ave.	150	152	250	8	VCP	83	/B	/A	/A	/A	/A
J	12	Railroad Ave., W of Boiling Spr.	150	170	465	18	VCP	155	B/B	A/A	A/A	A/A	A/A
J	19	Main St., E of Everette Pl.	184	185	260	8	VCP	87	A/A	A/A	A/A	A/A	A/A
J	33	Railroad Ave., W of Uhland St.	200	210	415	8	VCP	138	A/A	A/A	A/A	A/A	A/A
J	35	Main St., E of Humboldt St.	211	212	325	8	VCP	108	/A	/A	/A	/A	/A
J	37	Main St., W of Humboldt St.	211	214	300	8	VCP	100	A/B	A/A	A/A	A/A	A/A
J	38	Railroad Ave., W of Humboldt St.	210	230	425	18	VCP	142	B/B	A/A	A/A	A/A	A/A
J	40	Clinton Pl., S of Grove St.	230	232	690	8	VCP	230	A/B	A/A	A/A	A/A	A/A
J	42	Clinton Pl., N of Grove St.	232	234	710	8	VCP	237	B/B	A/A	A/A	A/A	A/A
J	44	Grove St., E of Clinton Pl.	232	235	355	8	VCP	118	A/A	A/A	A/A	A/A	A/A
J	45	Humboldt St., N of Grove St.	235	236	530	8	VCP	177	A/A	A/A	A/A	A/A	A/A
J	46	Grove St., E of Humboldt St.	235	237	310	8	VCP	103	A/A	A/A	A/A	A/A	A/A
J	47	Humboldt St., N of Main St.	235	238	230	8	VCP	77	A/A	A/A	A/A	A/A	A/A
J	48	Railroad Ave., W of Clinton Pl.	230	250	400	15	VCP	133	B/A	A/A	A/A	A/A	A/A
J	52	Railroad Ave., W of Mozart St.	250	L100	400	15	VCP	133	/B	/A	/A	/A	/A
Subtotals - Minisystem J					8186			2729					
					MINISYSTEM L								
L	2	Central Ave. & Oak St.*	330	337	150	8	VCP	50	A/A	A/A	A/A	A/A	A/A
L	3	Oak St. & Central Ave.*	330	331	200	8	VCP	67	A/A	A/A	A/A	A/A	A/A
Subtotals - Minisystem L					350			117					
TOTALS - EAST RUTHERFORD					8536			2846					

*Reach is included only in indirect inflow reduction phase.

(1) Manhole Depth	(2) Rung Condition	(3) Flow Depth	Sedimentation (4) Depth	Sedimentation (5) Type
A. 0-8 ft	A. Sound	A. 0-1/4 Pipe	A. None	A. None
B. 8-12 ft	B. Unusable	B. 1/4-1/2 Pipe	B. Negl.- 1 in.	B. Sludge
C. 12-20 ft	C. None	C. 1/2 Pipe+	C. 1-3 in.	C. Soil
D. 20 ft+			D. 3 in.+	D. Grease
				E. Detergent
				F. Debris
				G. Paper

Note: The data is based on manhole inspections completed in 1982.

RERC JOINT MEETING - RUTHERFORD

DATA ON REACHES AND MANHOLES IN
RECOMMENDED TEST-AND-SEAL CONTRACT

			REACH DATA						MANHOLE DATA (Upper MH/Lower MH)				
			Limits									Sedimentation	
Mini-system	Reach	Location	Lower MH	Upper MH	Length (ft)	Diameter (inch)	Type Pipe	Approximate No. of Jts.	Depth (1)	Rungs (2)	Approximate Flow (3)	Depth (4)	Type (5)
					MINISYSTEM P								
P	6	Springdale, E of Orient Way	120	121	265	8	VCP	88	B/B	C/A	A/A	A/A	A/A
P	12	Passaic Ave. & Mountain Way*	140	150	440	8	VCP	147	A/A	A/A	A/A	A/A	A/A
P	16	Passaic Ave., E of the Terrace	160	164	165	8	VCP	55	A/A	A/A	A/A	A/A	A/A
P	17	Sylvan St., S of Passaic Ave.	160	163	555	8	VCP	185	A/A	A/A	A/A	A/A	A/A
P	22	Orient Way, N of Highland Cross*	170	180	450	8	VCP	150	A/A	A/A	A/A	A/A	A/A
P	26	Mountain Way, S of Passaic Ave.	182	155	530	8	VCP	177	A/A	A/A	A/A	A/A	A/A
P	30	Highland Cross @ Sylvan St.	183	185	305	8	VCP	102	A/A	A/A	A/A	A/A	A/A
P	32	Orient Way at Summit Cross	180	220	980	8	VCP	327	A/A	A/A	A/A	A/A	A/A
P	36	Summit Cross & Mountain Way*	222	223	200	8	VCP	67	A/A	A/A	A/A	A/A	A/A
P	39	Summit Cross, E of Mountain Way	220	240	385	8	VCP	327	A/A	A/A	A/A	A/A	A/A
P	43	Summit Cross, W of Sylvan St.	240	294	189	8	VCP	63	A/A	A/A	A/A	A/A	A/A
Subtotals - Minisystem P					4464			1688					
					MINISYSTEM Q								
Q	1	Station Ave., E of Park Ave.	D170	100	275	8	VCP	92	B/B	A/A	A/A	A/A	A/A
Q	2	Station Ave., W of Park Ave.	100	110	500	8	VCP	167	B/B	A/A	A/A	A/A	A/A
Q	4	Station Ave., W of Kipp Ave.	110	111	170	8	VCP	57	B/B	A/A	A/A	A/A	A/A
Q	5	Kipp Ave., S of Station Ave.	110	113	440	8	VCP	147	B/B	A/A	A/A	A/A	A/A
Q	21	Park Ave., S of Passaic Ave.	160	180	534	8	VCP	178	A/A	A/A	A/A	A/A	A/A
Q	25	Park Ave., S of Donaldson Ave.	180	220	536	8	VCP	179	A/A	A/A	A/A	A/A	A/A
Q	36	Lincoln Ave., E of Park Ave.	160	162	615	8	VCP	205	A/A	A/A	A/A	A/A	A/A
Q	39	Lincoln Ave., W of Summit Cross	162	374	489	8	VCP	163	B/A	B/A	A/A	A/A	A/A
Q	44	Ridge Rd. & Summit Cross	360	374	810	8	VCP	270	B/A	B/A	A/A	A/A	A/A
Q	52	Ridge Rd., S of Summit Cross	340	360	295	8	VCP	98	B/B	A/A	A/A	A/A	A/A
Q	54	Ridge Rd., S of Addison Ave.	381	384	240	8	VCP	80	A/A	B/A	A/A	A/A	A/A
Q	58	Ridge Rd., S of Pierrepont Ave.	322	324	335	8	VCP	112	B/B	A/B	A/A	A/A	A/A
Q	60	Lincoln Ave. @ Newell Ave.	374	381	540	8	VCP	180	A/A	A/A	A/A	A/A	A/A
Q	61	Newell Ave., W of Lincoln Ave.	378	380	560	8	VCP	187	A/A	A/A	A/A	A/A	A/A
Q	64	Lincoln Ave., S of Addison Ave.	381	384	240	8	VCP	80	A/A	B/A	A/A	A/A	A/A
Subtotals - Minisystem Q					6579			2195					

Continued on Sheet 3 of 3

*Reach is included only in indirect inflow reduction phase.

(1) Manhole Depth
- A. 0-8 ft
- B. 8-12 ft
- C. 12-20 ft
- D. 20 ft+

(2) Rung Condition
- A. Sound
- B. Unusable
- C. None

(3) Flow Depth
- A. 0-1/4 Pipe
- B. 1/4-1/2 Pipe
- C. 1/2 Pipe+

Sedimentation

(4) Depth
- A. None
- B. Negl.- 1 in,
- C. 1-3 in.
- D. 3 in.+

(5) Type
- A. None
- B. Sludge
- C. Soil
- D. Grease
- E. Detergent
- F. Debris
- G. Paper

Note: The data is based on manhole inspections completed in 1982.

RERC JOINT MEETING - RUTHERFORD

DATA ON REACHES AND MANHOLES IN RECOMMENDED TEST-AND-SEAL CONTRACT

			REACH DATA						MANHOLE DATA (Upper MH/Lower MH)				
			Limits									Sedimentation	
Mini-system	Reach	Location	Lower MH	Upper MH	Length (ft)	Diameter (inch)	Type Pipe	Approximate No. of Jts.	Depth (1)	Rungs (2)	Approximate Flow (3)	Depth (4)	Type (5)
					MINISYSTEM R								
R	1	Union Ave. @ Agnew Pl.	100	120	445	10	VCP	148	B/B	A/A	A/A	A/A	A/A
R	3	Chestnut St., S of Union Ave.	120	122	910	8	VCP	303	A/B	B/A	A/A	A/A	A/A
R	4	Station Ave., W of Chestnut St.	121	124	311	8	VCP	104	A/A	B/A	A/A	A/A	A/A
R	10	Union Ave., N of Chestnut St.	120	130	352	8	VCP	117	B/B	A/A	A/A	A/A	A/A
R	11	Home Ave., N of Fairview Ave.*	130	150	689	8	VCP	230	A/A	A/A	A/A	A/A	A/A
R	15	Elliot Pl., W of Station Ave.	331	332	170	8	VCP	57	A/A	A/A	A/A	A/A	A/A
R	20	Passaic Ave., S of Home Ave.	180	200	600	8	VCp	200	B/B	B/A	A/A	A/A	A/A
R	22	Mortimer Ave. & Donaldson Ave.	200	205	1233	8	VCP	411	/B	/B	/A	/A	/A
R	27	Union Ave. @ Maple St.	130	220	600	8	VCP	200	B/B	B/A	A/A	A/A	A/A
R	33	Mortimer Ave., S of Union Ave.	220	240	420	8	VCP	140	A/B	A/B	A/A	A/A	A/A
R	35	Mortimer Ave., N of Fairview Ave.	240	270	490	8	VCP	163	A/A	A/A	A/A	A/A	A/A
R	39	Mortimer Ave., S of Fairview Ave.	270	290	570	8	VCP	190	A/A	B/A	A/A	A/A	A/A
R	49	Passaic Ave., W of Wood St.	200	206	636	8	VCP	212	B/B	A/B	A/A	A/A	A/A
R	53	Fairview Ave., W of Wood St.	360	361	120	8	VCP	40	A/A	A/A	A/A	A/A	A/A
R	58	Wood Str., N of Fairview Ave.	330	360	515	8	VCP	172	A/A	A/A	A/A	A/A	A/A
R	61	Estate St., W of Wood St.	330	331	255	8	VCP	85	A/A	A/A	A/A	A/A	A/A
R	62	Hackett Pl., N of Station Ave.	331	332	170	8	VCP	57	A/A	A/A	A/A	A/A	A/A
R	64	Wood St., S of Union Ave.	310	330	400	8	VCP	133	A/B	A/B	A/A	A/A	A/A
R	66	Union Ave., N of Wood St.	300	380	530	8	VCP	177	B/B	A/B	A/A	A/A	A/A
R	73	Union Ave., W of Hackett Pl.	380	400	790	8	VCP	263	B/B	A/A	A/A	A/A	A/A
Subtotals - Minisystem R					10206			3402					
					MINISYSTEM S								
S	1	Maple St. & Washington Ave.*	120	140	400	8	VCP	133	A/A	B/A	A/A	A/A	A/A
Subtotals - Minisystem S					400			133					
					MINISYSTEM U								
U	7	Armack & Veterans Blvd.*	150	170	247	18	RCP	82	C/C	A/A	A/A	A/A	A/A
U	9	Veterans Blvd. (Central Part)	170	171	261	18	RCP	87	C/C	A/A	A/A	A/A	A/A
Subtotals - Minisystem U					508			169					
TOTALS - RUTHERFORD					30979			10509					

*Reach is included only in indirect inflow reduction phase.

(1) Manhole Depth	(2) Rung Condition	(3) Flow Depth	Sedimentation (4) Depth	Sedimentation (5) Type
A. 0-8 ft	A. Sound	A. 0-1/4 Pipe	A. None	A. None
B. 8-12 ft	B. Unusable	B. 1/4-1/2 Pipe	B. Negl.- 1 in.	B. Sludge
C. 12-20 ft	C. None	C. 1/2 Pipe+	C. 1-3 in.	C. Soil
D. 20 ft+			D. 3 in.+	D. Grease
				E. Detergent
				F. Debris
				G. Paper

Note: The data is based on manhole inspections completed in 1982.

RERC JOINT MEETING

SUMMARY OF RECOMMENDED PROGRAM TO REDUCE I/I FROM SPECIFIC SOURCES ON PUBLIC PROPERTY

RERC-JM Borough	Minisystem	Catch Basin Diversion (1)				Cross-Connection Inflow Elimination (2)				Leaky Manhole Grouting (3)				Floodprone Manhole Cover Replacement (4)				Total Program to Reduce I/I From Specific Sources on Public Property			
		Sources	Flow Reduction (gpd) Avg*	Flow Reduction (gpd) Peak**	Repair Cost ($1000)	Sources	Flow Reduction (gpd) Avg*	Flow Reduction (gpd) Peak**	Repair Cost ($1000)	Sources	Flow Reduction (gpd) Avg*	Flow Reduction (gpd) Peak**	Repair Cost ($1000)	Sources	Flow Reduction (gpd) Avg*	Flow Reduction (gpd) Peak**	Repair Cost ($1000)	Flow Reduction (gpd) Avg*	Flow Reduction (gpd) Peak**	Benefit ($1000) (6)	Repair Cost ($1000) (5)
Carlstadt	A	-	-	-	-	-	-	-	-	1	36	360	0.20	5	75	9,000	1.20	111	9,360	35.05	1.40
	B	-	-	-	-	-	-	-	-	1	36	360	0.20	-	-	-	-	36	360	0.25	0.20
	C	-	-	-	-	-	-	-	-	1	36	360	0.20	-	-	-	-	36	360	0.25	0.20
	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	F	-	-	-	-	-	-	-	-	2	216	2,160	0.40	-	-	-	-	216	2,160	1.51	0.40
Subtotals		-	-	-	-	-	-	-	-	5	324	3,240	1.00		75	9,000	1.20	399	12,240	37.06	2.20
E. Rutherford	G	-	-	-	-	-	-	-	-	2	72	720	0.40	-	-	-	-	72	720	0.50	0.40
	H	-	-	-	-	-	-	-	-	2	72	720	0.40	-	-	-	-	72	720	0.50	0.40
	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	J	1	710	85,200	14.0	-	-	-	-	5	756	7,560	1.00	-	-	-	-	1,466	92,760	5.35	15.00
	K	-	-	-	-	-	-	-	-	1	36	360	0.20	-	-	-	-	36	360	0.25	0.20
	L	-	-	-	-	-	-	-	-	1	36	360	0.20	-	-	-	-	36	360	0.25	0.20
Subtotals		1	710	85,200	14.0	-	-	-	-	11	972	9,720	2.20		-	-	-	1,682	94,920	6.85	16.20
Rutherford	M	1	210	25,200	8.0	-	-	-	-	3	252	2,520	0.60	-	-	-	-	462	27,720	18.06	8.60
	N	-	-	-	-	-	-	-	-	1	36	360	0.20	-	-	-	-	36	360	0.25	0.20
	O	-	-	-	-	2	1,000	120,000	12.5	-	-	-	-	-	-	-	-	1,000	120,000	77.40	12.50
	P	1	890	106,800	8.0	-	-	-	-	2	72	720	0.40	-	-	-	-	962	107,520	69.40	8.40
	Q	3	2,250	270,800	24.0	-	-	-	-	1	180	1,800	0.20	-	-	-	-	2,430	272,600	175.36	24.20
	R	-	-	-	-	-	-	-	-	2	216	2,160	0.40	-	-	-	-	216	2,160	1.51	0.40
	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	T	-	-	-	-	-	-	-	-	2	72	720	0.40	-	-	-	-	72	720	0.50	0.40
	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	UM	-	-			-				-	-	-	-	-	-	-	-	-	-	-	-
Subtotals		5	3,350	402,800	40	2	1,000	120,000	12.5	11	828	8,280	2.20		-	-	-	5,178	531,080	342.48	54.70
RERC-JM TOTALS		6	4,060	488,000	54.0	2	1,000	120,000	12.5	27	2,124	21,240	5.40		75	9,000	1.20	7,259	638,240	386.39	73.10

Notes:

(1) For details, see Table 4a.
(2) For details, see Table 4b.
(3) For details, see Table 4c.
(4) For details, see Table 4d.
(5) Based on 1981 estimate, 1984 costs may be about 20 percent higher.
(6) Overall 1981 benefit based on $0.64 per gpd that the peak flow is reduced and $0.60 per gpd that the average flow is reduced.

*Annual average.
**Coincident peaks.

RERC JOINT MEETING

CATCH BASIN DIVERSIONS

RERC-JM Borough	Mini-system	Nearest Manhole	Location	Tributary Area (1000 sq ft)	Imperviousness (pct)	Avg Flow (gpd)(2)	Peak Flow (gpd) (3)	Possible Method of Diversion	Benefit of Diversion ($1000) (4)	Diversion Cost ($1000) (5)	Benefit/ Cost Ratio
Carlstadt				NO SOURCES LOCATED							
E. Rutherford	J	235	Curb in front of 125 Humboldt St.	10.0	95	710	85,200	(1)	54.9	14.0	3.9
Rutherford	M	290	Curb in front of 264 Orient Way	3.0	95	210	25,200	(1)	16.3	8.0	2.0
	P	180	Curb in front of 161 Orient Way	12.5	95	890	106,800	(1)	68.9	8.0	8.6
	Q	122	NW Corner of Spring Dell @ Sylvan St.	12.0	95	860	103,200	(1)	66.6	8.0	8.3
	Q	122	SW Corner of Spring Dell @ Sylvan St.	4.0	95	290	34,800	(1)	22.4	8.0	2.8
	Q	122	NE Corner of Spring Dell @ Sylvan St.	15.0	95	1100	132,800	(1)	85.1	8.0	10.6
Subtotals						3350	402,800		259.3	40.0	6.5
RERC-JM TOTALS						4060	488,000		314.2	54.0	5.8

Notes:

(1) Pipe to storm sewer.
(2) Avg flow gpd = 0.75 x area tributary (1000 sq ft) x percent imperviousness.
(3) Coincident peak flow = 120 x average flow.
(4) Benefit of diversion (1981) = $77.4/avg gpd reduced, based on ($0.64 x peak gpd x 120 avg/peak) + ($0.60 x avg gpd).
(5) Diversion cost (1981) = $5000 + ($60 x length of pipe needed-ft.).

RERC JOINT MEETING

STORM/SANITARY INFLOW REDUCTIONS

RERC-JM Borough	Mini-system	Manhole	Location	Description	Avg Flow (gpd) (1)	Peak Flow (gpd) (2)	Benefit of Diversion ($1000) (3)	Possible Method of Diversion	Diversion Cost ($1000) (4)	Benefit/Cost Ratio
Carlstadt				NO SOURCES LOCATED						
E. Rutherford				NO SOURCES LOCATED						
Rutherford	0	120/130	Meadow Rd. @ Passaic Ave.	(6)	500	60,000	38.7	(8)	10.0	3.9
	0	160	Feronia Way N of Passaic Ave.	(5)	500	60,000	38.7	(7)	2.5	15.5
Subtotals					1,000	120,000	77.4		12.5	6.2
RERC-JM TOTALS					1,000	120,000	77.4		12.5	6.2

Notes:

(1) See Table VIII-4.
(2) Coincident peak flow = 120 x average flow.
(3) Benefit of diversion (1981) = $77.4/avg gpd reduced, based on ($0.64 x peak gpd x 120 avg/peak) + ($0.60 x avg gpd).
(4) The 1981 diversion cost of the more costly alternative.
(5) Pipe between manhole and storm ditch.
(6) Suspected pipe between storm and sanitary system.
(7) Plug interconnection or install flap valve on pipe at ditch.
(8) Televise to determine exact location. Either excavate and disconnect or construct manhole with flap valve on storm sewer.

TABLE 4d

RERC JOINT MEETING

FLOODPRONE MANHOLE COVER REPLACEMENTS

RERC-JM Borough	Mini-system	Manhole	Location	Type of Source	Benefit ($)(1)	Benefit/ Cost Ratio(2)
Carlstadt	A	147	Broad St. E of Twentieth St.	(3)	5,805	29.0
	A	146	Broad St. E of Twentieth St.	(3)	5,805	29.0
	A	145	Broad St. E of Twentieth St.	(3)	5,805	29.0
	A	144	Broad St. E of Twentieth St.	(3)	5,805	29.0
	A	143	Broad St. E of Twentieth St.	(3)	5,805	29.0
	A	142	Broad St. E of Twentieth St.	(3)	5,805	29.0
Subtotals					34,830	29.0
E. Rutherford			NO SOURCES LOCATED			
Rutherford			NO SOURCES LOCATED			
RERC-JM TOTALS					34,830	29.0

Notes:

(1) Installing solid gasketed cover may reduce average flow by 75 gpd and the peak flow by 9000 gpd. The 1981 overall benefit of reduction = ($0.60 x 75 gpd avg.) + (0.64 x 9000 gpd peak).
(2) Manhole cover replacement cost is $200 per cover based on 1981 estimate.
(3) Manholes in street reported to flood during the combination of very wet weather and high tide.

RERC JOINT MEETING

LEAKY MANHOLES COST-EFFECTIVE REPAIRS

RERC-JM Borough	Mini-system	Manhole	Location	Type of Leak	Avg Flow (gpd)(1)	Peak Flow (gpd)(2)	Flow Reduction Benefit ($)(3)	Repair Cost ($)(4)	Benefit/Cost Ratio
Carlstadt	A	142	Broad St. E of Twentieth St.	(5)	36	360	252	200	1.3
	B	150	Broad St. @ Fourteenth St.	(5)	36	360	252	200	1.3
	C	110	Hoboken E of Hackensack St.	(5)	36	360	252	200	1.3
	F	160	Garden St. @ Broad St.	(5)	36	360	252	200	1.3
	F	899	Industrial Ave. W of Garden St.	(6)	180	1800	1260	200	6.3
Subtotals					324	3240	2268	1000	2.3
E. Rutherford	G	161	Union Ave. @ DuBois St.	(5)	36	360	252	200	1.3
	G	100	Row E of Rt. 17	(5)	36	360	252	200	1.3
	H	190	Stanley St. E. of Cornelia St.	(5)	36	360	252	200	1.3
	H	154	Ann St. @ Francis St.	(5)	36	360	252	200	1.3
	J	250	Railroad Ave. @ Mozart St.	(6)	180	1800	1260	200	6.3
	J	240	Railroad Ave. S of Mozart St.	(6)	180	1800	1260	200	6.3
	J	230	Railroad Ave. @ Clinton Pl.	(6)	180	1800	1260	200	6.3
	J	210	Railroad Ave. @ Humboldt St.	(5)	36	360	252	200	1.3
	J	180	Railroad Ave. @ Everett Pl.	(6)	180	1800	1260	200	6.3
	K	130	Mozart St. N of Grove St.	(5)	36	360	252	200	1.3
	L	290	Oak St. @ Central Ave.	(5)	36	360	252	200	1.3
Subtotals					972	9720	6804	2200	3.1
Rutherford	M	100	Rt. 17 @ Summit Cross	(5)	36	360	252	200	1.3
	M	190	Pierrepont Ave. @ Eastern Way	(5)	36	360	252	200	1.3
	M	350	Orient Way @ Barrows Ave.	(6)	180	1800	1260	200	6.3
	N	111	Eastern Way N of Summit Cross	(5)	36	360	252	200	1.3
	P	110	Orient Way @ Glen Rd.	(5)	36	360	252	200	1.3
	P	182	Mountain Way @ Summit Cross	(5)	36	360	252	200	1.3
	Q	100	Park St. @ Ames Ave.	(6)	180	1800	1260	200	6.3
	R	240	Mortimer Ave. S of Union Ave.	(5)	36	360	252	200	1.3
	R	330	Wood St. @ Estate St.	(6)	180	1800	1260	200	6.3
	T	130	Erie Ave. E of Maple St.	(5)	36	360	252	200	1.3
	T	250	Erie Ave. @ Hasbrouck Pl.	(5)	36	360	252	200	1.3
Subtotals					828	8280	5796	2200	2.6
RERC-JM TOTALS					2124	21240	14868	5400	2.8

Notes:

(1) Avg flow - See Table VIII-4.
(2) Peak flow = 10 x avg flow.
(3) Flow reduction benefit based on 1981 estimate = $7.0 avg gpd reduced, based on ($0.64 x peak gpd x 10 x avg/peak) + (0.60 x avg gpd).
(4) Repair cost based on 1981 estimate = $200 per repair
(5) Typical leak.
(6) High rate leak.

RERC JOINT MEETING

SUMMARY OF RECOMMENDED I/I REDUCTION PROGRAM ON PRIVATE PROPERTY

RERC-JM Borough	Minisystem	Roof Drain Diversion (1) Sources	Roof Drain Flow Reduction (gpd) Avg*	Roof Drain Flow Reduction (gpd) Peak**	Roof Drain Repair Cost ($1000)	Surface Drain Diversions (2) Sources	Surface Drain Flow Reduction (gpd) Avg*	Surface Drain Flow Reduction (gpd) Peak**	Surface Drain Repair Cost ($1000)	Total Flow Reduction (gpd) Avg*	Total Flow Reduction (gpd) Peak**	Total Benefit ($1000) (3)	Total Repair Cost ($1000) (4)
Carlstadt	A	1	3,000	360,000	0.3	-	-	-	-	3,000	360,000	232.0	0.3
	B	-	-	-	-	-	-	-	-	-	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-
	D	-	-	-	-	-	-	-	-	-	-	-	-
	E	-	-	-	-	1	142	17,040	0.3	142	17,040	11.0	0.3
	F	-	-	-	-	3	377	45,240	0.3	377	45,240	29.3	0.3
Subtotals		1	3,000	360,000	0.3	4	519	62,280	0.6	3,519	422,280	272.3	0.9
E. Rutherford	G	-	-	-	-	-	-	-	-	-	-	-	-
	H	-	-	-	-	-	-	-	-	-	-	-	-
	I	-	-	-	-	-	-	-	-	-	-	-	-
	J	1	285	34,200	0.6	-	-	-	-	285	-	-	-
	K	1	375	45,000	0.6	-	-	-	-	375	-	-	-
	L	-	-	-	-	-	-	-	-	-	-	-	-
Subtotals		2	660	79,200	1.2	-	-	-	-	660	79,200	51.1	1.2
Rutherford	M	1	75	9,000	0.6	1	30	3,600	0.1	105	12,600	8.1	0.7
	N	-	-	-	-	-	-	-	-	-	-	-	-
	O	-	-	-	-	-	-	-	-	-	-	-	-
	P	-	-	-	-	1	3	360	0.1	3	360	0.2	0.1
	Q	-	-	-	-	-	-	-	-	-	-	-	-
	R	-	-	-	-	1	84	10,080	0.1	84	10,080	6.5	0.1
	S	-	-	-	-	-	-	-	-	-	-	-	-
	T	-	-	-	-	-	-	-	-	-	-	-	-
	U	-	-	-	-	1	30	3,600	1.0	-	-	-	-
	UM	-	-	-	-	-	-	-	-	30	3,600	2.3	1.0
Subtotals		1	75	9,000	0.6	4	147	17,640	12.5	222	26,640	17.1	1.9
RERC-JM TOTALS		4	3,735	488,200	2.1	8	666	79,920	1.9	4,401	528,120	340.5	4.0

Notes:

(1) For details, see Table 5a.
(2) For details, see Table 5b.
(3) Based on 1981 estimate, 1984 costs are estimated about 20% higher.
(4) Overall 1981 benefit based on $0.64 per gpd that the peak flow is reduced and $0.60 per gpd that the average flow is reduced.

*Annual average.
**Coincident peak.

RERC JOINT MEETING

ROOF DRAIN DIVERSIONS

RERC-JM Borough	Mini-system	Nearest Manhole	Address	Roof Area (1000 sq ft)	Location of Drain	Average Flow(1) (gpd)	Peak Flow(2) (gpd)	Benefit of Diversion(3) ($1000)	Cost ($1000)(4)	Benefit/Cost Ratio
Carlstadt	A	146	50 Broad St.	40.0	Center of S side of bldg.	3,000	360,000	232.0	0.3	773
E. Rutherford	J	236	126 Humboldt St.	3.8	SE corner of house	285	34,200	22.1	0.6	37
	K	221	306 Laurel Pl.	5.0	NE corner of house	375	45,000	29.0	0.6	48
Subtotals				8.8		660	79,200	51.1	1.2	43
Rutherford	M	161	43 Elycroft Pkwy.	1.0	NW corner of house	75	9,000	5.8	0.6	10
RERC-JM TOTALS				49.8		3,735	448,200	288.9	2.1	137.6

Notes:

(1) Average flow = 75 x area tributary (1000 sq ft).
(2) Coincident peak flow = 120 x average flow.
(3) Benefit of diversion (1981) = $77.4/avg gpd reduced, based on ($0.64 x peak gpd x 120 avg/peak) + ($0.60 x avg gpd).
(4) Based on 1981 cost of disconnecting and piping flow to curb. If diversion to splash pan is acceptable, cost would be less.

RERC JOINT MEETING

SURFACE DRAIN DIVERSIONS

RERC-JM Borough	Mini-system	Nearest Manhole	Address	Type of Drain(1)	Contributing Area (1000 sq ft)	Percent Impervious	Average Flow(2) (gpd)	Peak Flow(3) (gpd)	Benefit ($1000)(4)	Possible Method of Diversion(5)	Cost ($1000)(6)	Benefit/Cost Ratio
Carlstadt	E	145	576 Central Ave.	B	2.0	95	142	17,040	11.0	A	0.3	37
	F	140	20' N of Hoboken Ave. Curb, 40' E of Garden St. Curb in Factory Lawn	A	0.9	20	135	16,200	10.5	B	0.1	105
	F	905	575 Industrial Ave., near Bldg. 10' W of SE corner	A	0.9	95	64	7,680	5.0	B	0.1	50
	F	905	575 Industrial Ave., 20' SE of	A	2.5	95	178	21,360	13.8	B	0.1	138
Subtotals					6.3		519	62,280	40.3		0.6	67.2
E. Rutherford			NO SOURCES LOCATED									
Rutherford	M	352	Across from 33 Barrows Ave., in Woods, 63' from Pole 60457, 92' from Pole 60456	A	2.0	20	30	3,600	2.3	B	0.1	23
	P	111	14 Glen Rd. @ NW Corner of House	A	0.2	20	3	360	0.2	B	0.1	2
	R	301	124 Fairview Ave., 15' NW of NW Corner of House	A	5.6	20	84	10,080	6.5	B	0.1	65
	U	160/170	N of N Curb Veterans Blvd., 40'	C	2.0	20	30	3,600	2.3	C	1.0	2
Subtotals					9.8		147	17,640	11.3		1.3	8.7
RERC-JM TOTALS					16.1		666	79,920	51.6		1.9	27.2

Notes:

(1) Type of drain: (A) Open cleanout
(B) Driveway
(C) Open building connection
(2) Avg flow = 0.75 x area tributary (1000 sq ft) x percent imperviousness.
(3) Coincident peak flow = 120 x average flow.
(4) Benefit of diversion (1981) = $77.5/avg gpd reduced, based on ($0.64 x peak gpd x 120 avg peak) x ($0.60 x avg gpd).
(5) Method of Diversion: (A) Pipe to curb or storm
(B) Seal drain or cleanout
(C) Excavate and seal
(6) Based on 1981 costs.

TABLE 6

RERC JOINT MEETING

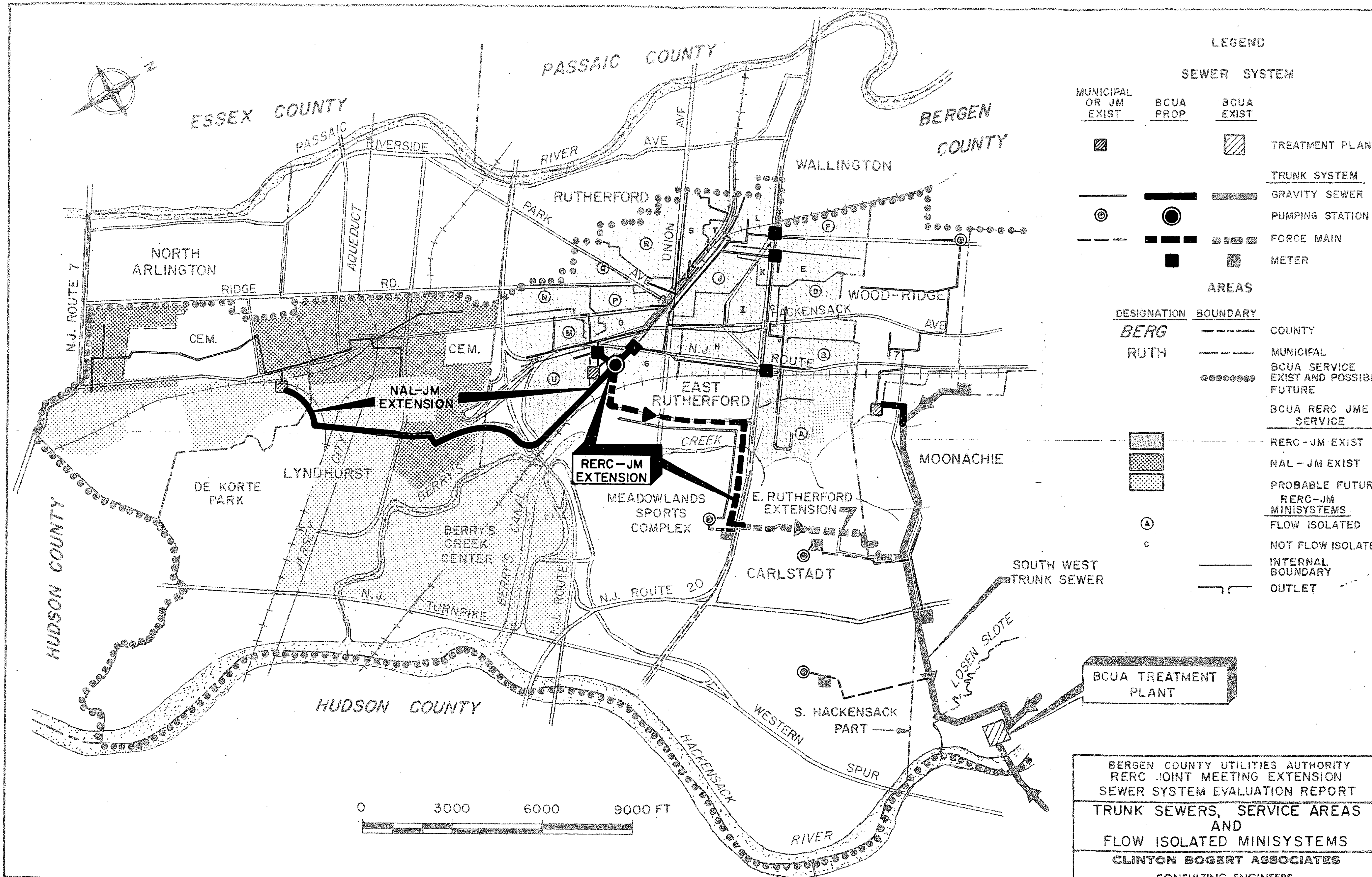
SYSTEM DEFECTS NOT SCHEDULED FOR REPAIR
UNDER THE I/I REDUCTION PROGRAM

RERC-JM Borough	Mini-system	Nearest Manhole	Location(1)	Structural Defects(2)		
				Manhole	Mun. Sewer	Bldg. Sewer
Carlstadt	E	144	576 Central Ave., S of Driveway Ret. Wall near Front Door			I
	F	170	Broad St. @ Orchard St. , NE Corner		C	
E. Rutherford	L	370	N Side of Paterson Ave., from San. Sewer Constructed thru Storm Sewer, 5' W. of Pole 651 WN			C
Rutherford	M	190/191	227 Eastern Way, in Street, 4' W of E Curb, 33' from Pole 62007, 37' from Pole 61810			C
	M	290	275 Orient Way, in Grass, 2' E of E Curb at S Edge of Walk to Door			I,C
	M	292	233 Orient Way, in Grass, 2' E of E Curb under No Parking Sign			I,C

Notes:

(1) Location that smoke was sighted from municipal or building sewers.
(2) Structural defects: C - Cracks or breaks
I - Smoke from ground, probable infiltration source
J - Open or sheared joints

PLATES



LEGEND
SEWER SYSTEM
MUNICIPAL OR JM EXIST
BCUA PROP
BCUA EXIST
TREATMENT PLANT
TRUNK SYSTEM
GRAVITY SEWER
PUMPING STATION
FORCE MAIN
METER
AREAS
DESIGNATION
BOUNDARY
BERG
COUNTY
RUTH
MUNICIPAL
BCUA SERVICE EXIST AND POSSIBLE FUTURE
BCUA RERC JME SERVICE
RERC-JM EXIST
NAL-JM EXIST
PROBABLE FUTURE RERC-JM MINISYSTEMS
FLOW ISOLATED
NOT FLOW ISOLATED
INTERNAL BOUNDARY
OUTLET
ESSEX COUNTY
PASSAIC COUNTY
BERGEN COUNTY
HUDSON COUNTY
PASSAIC RIVER
RIVERSIDE AVE
PARK AVE
UNION AVE
RUTHERFORD
WALLINGTON
NORTH ARLINGTON
RIDGE RD.
AQUEDUCT
N.J. ROUTE 7
CEM.
WOOD-RIDGE
HACKENSACK AVE
N.J. ROUTE 17
EAST RUTHERFORD
NAL-JM EXTENSION
RERC-JM EXTENSION
CREEK
LYNDHURST
DE KORTE PARK
BERRY'S
MOONACHIE
MEADOWLANDS SPORTS COMPLEX
E. RUTHERFORD EXTENSION
CARLSTADT
BERRY'S CREEK CENTER
BERRY'S CANAL
N.J. ROUTE 20
N.J. TURNPIKE
JERSEY CITY
SOUTH WEST TRUNK SEWER
LOSEN SLOTE
BCUA TREATMENT PLANT
HUDSON COUNTY
S. HACKENSACK PART
WESTERN SPUR
HACKENSACK RIVER
0
3000
6000
9000 FT
BERGEN COUNTY UTILITIES AUTHORITY
RERC JOINT MEETING EXTENSION
SEWER SYSTEM EVALUATION REPORT
TRUNK SEWERS, SERVICE AREAS AND FLOW ISOLATED MINISYSTEMS
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

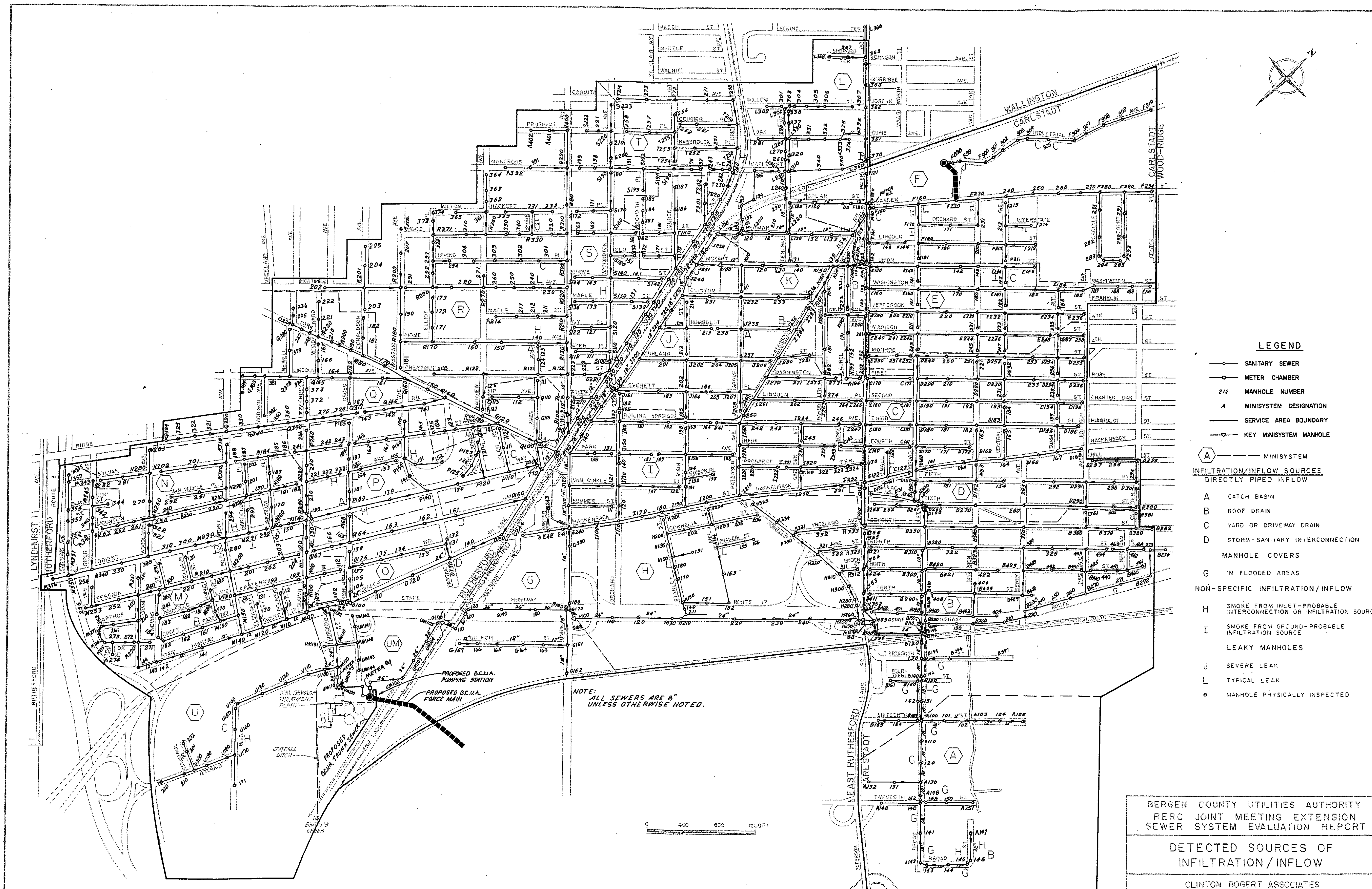

LEGEND
SANITARY SEWER
METER CHAMBER
212 MANHOLE NUMBER
A MINISYSTEM DESIGNATION
SERVICE AREA BOUNDARY
KEY MINISYSTEM MANHOLE
A MINISYSTEM
INFILTRATION/INFLOW SOURCES
DIRECTLY PIPED INFLOW
A CATCH BASIN
B ROOF DRAIN
C YARD OR DRIVEWAY DRAIN
D STORM-SANITARY INTERCONNECTION
MANHOLE COVERS
G IN FLOODED AREAS
NON-SPECIFIC INFILTRATION/INFLOW
H SMOKE FROM INLET-PROBABLE INTERCONNECTION OR INFILTRATION SOURCE
I SMOKE FROM GROUND-PROBABLE INFILTRATION SOURCE
LEAKY MANHOLES
J SEVERE LEAK
L TYPICAL LEAK
MANHOLE PHYSICALLY INSPECTED
NOTE: ALL SEWERS ARE 8" UNLESS OTHERWISE NOTED.
PROPOSED B.C.U.A. PUMPING STATION
PROPOSED B.C.U.A. FORCE MAIN
PROPOSED B.C.U.A. TRUNK SEWER
METER #4
WALLINGTON
CARLSTADT
EAST RUTHERFORD
LYNDHURST
RUTHERFORD
CARLSTADT WOOD-RIDGE
BERGEN COUNTY UTILITIES AUTHORITY
RERC JOINT MEETING EXTENSION
SEWER SYSTEM EVALUATION REPORT
DETECTED SOURCES OF INFILTRATION/INFLOW
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 2

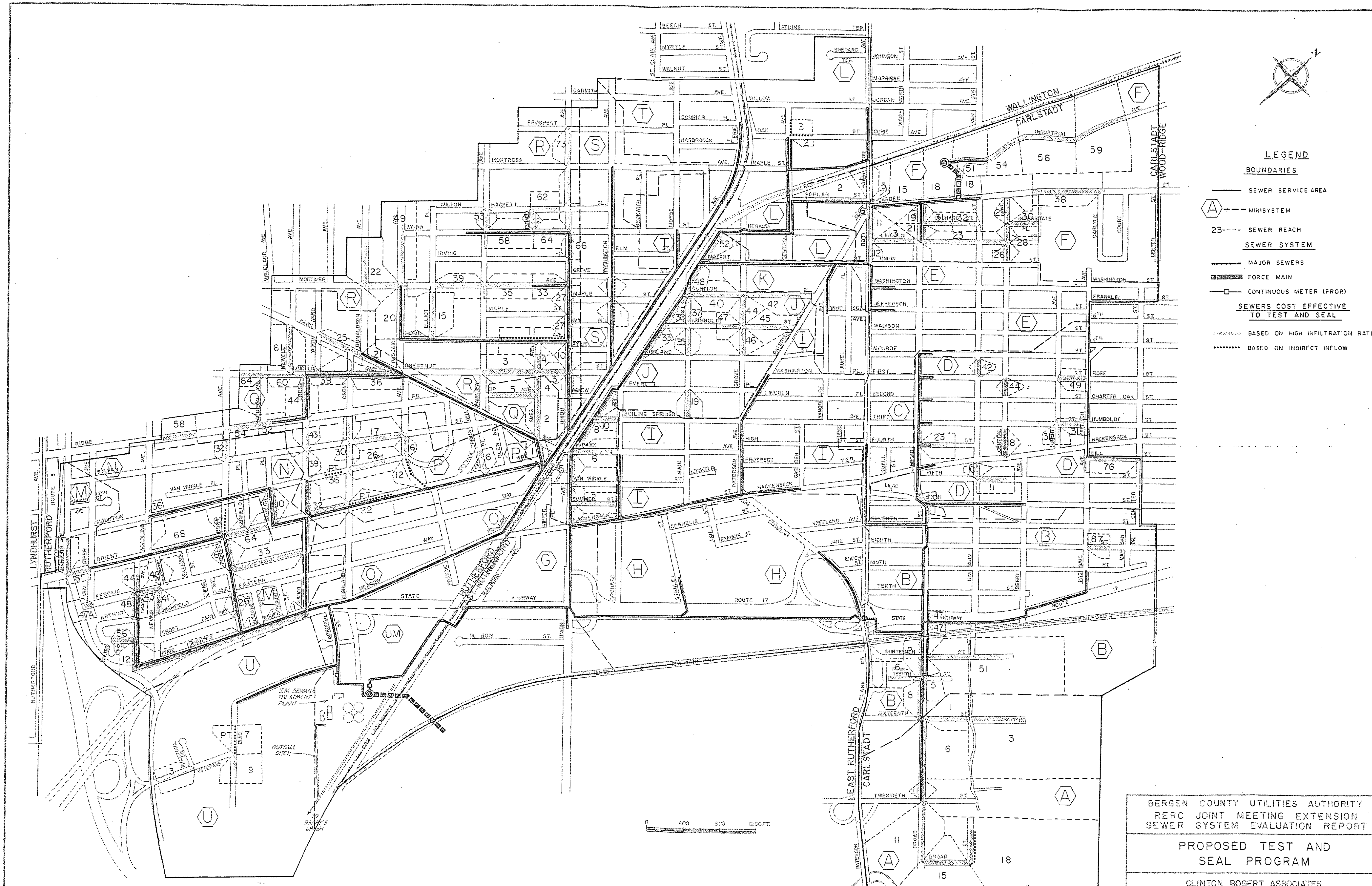
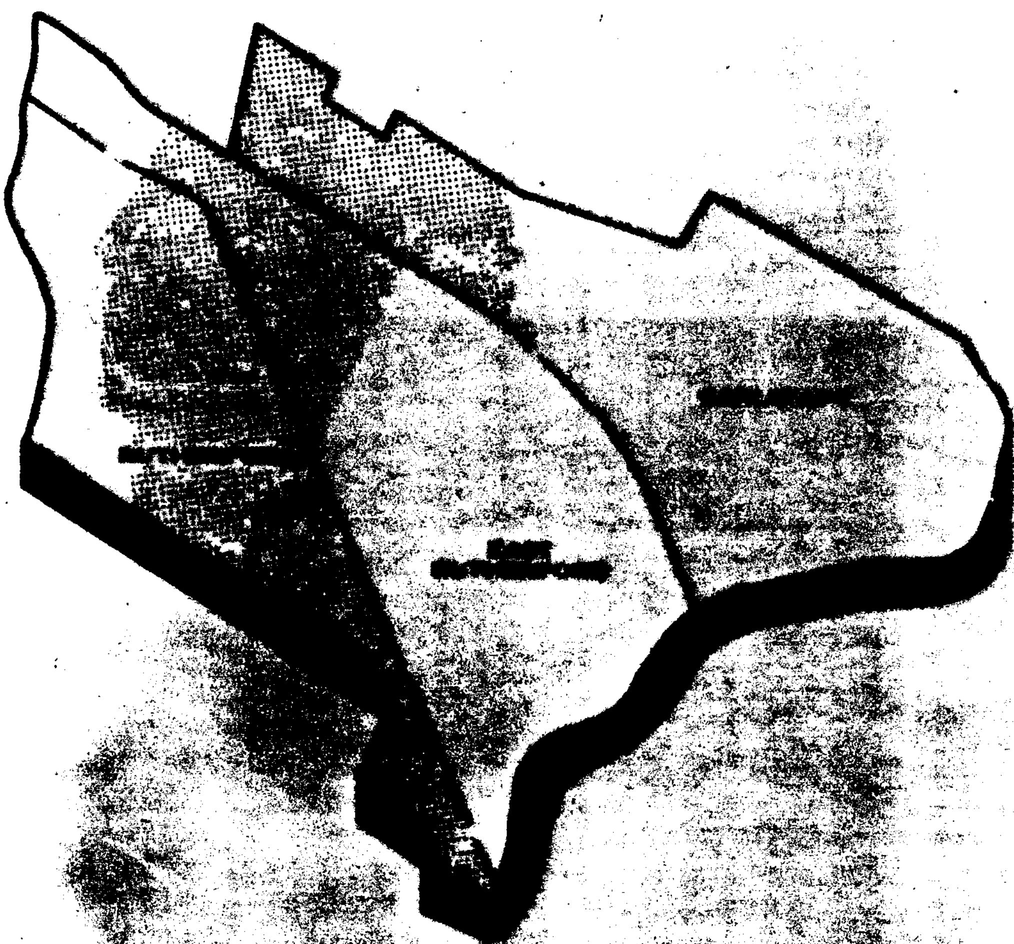

LEGEND
BOUNDARIES
SEWER SERVICE AREA
MINISYSTEM
23---- SEWER REACH
SEWER SYSTEM
MAJOR SEWERS
FORCE MAIN
CONTINUOUS METER (PROP)
SEWERS COST EFFECTIVE TO TEST AND SEAL
BASED ON HIGH INFILTRATION RATES
BASED ON INDIRECT INFLOW
WALLINGTON
CARLSTADT
CARLSTADT
WOOD-RIDGE
LYNDHURST
RUTHERFORD
EAST RUTHERFORD
CARLSTADT
J.M. SEWAGE TREATMENT PLANT
OUTFALL DITCH
TO BERRY'S CREEK
ROUTE 17
STATE HIGHWAY
BERGEN COUNTY UTILITIES AUTHORITY
RERC JOINT MEETING EXTENSION
SEWER SYSTEM EVALUATION REPORT
PROPOSED TEST AND SEAL PROGRAM
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 3

BERGEN COUNTY SEWER AUTHORITY

JOINT MEETING EXTENSION

FACILITY PLAN



CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

MAY, 1977

BERGEN COUNTY SEWER AUTHORITY

JOINT MEETING EXTENSION

FACILITY PLAN

DRAFT

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

MAY, 1977

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May 31, 1977

Bergen County Sewer Authority
Post Office Box 122
Little Ferry, New Jersey 07643

Re: Joint Meeting Extension
Facility Plan

Gentlemen:

In accordance with the terms of our contract dated January 29, 1974 and in compliance with U.S. Environmental Protection Agency Rules and Regulations, we are transmitting herewith a draft copy of the Joint Meeting Extension Facility Plan.

Conclusions and recommendations indicating the need to proceed with the final design and construction of the proposed Pumping Station and force main are on Pages 2-4.

Respectfully submitted,

CLINTON BOGERT ASSOCIATES

By: Ivan L. Bogert
Ivan L. Bogert
P.E., N.J. Lic. No. 6341

ILB/DHH:az
Encl.

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(Following Tables)

APPENDICES
(Separately Bound)

A. Preliminary Report on Sewerage Facilities June, 1966

B. 1971 Project Report Joint Meeting Extension

C. 1973 Project Report Joint Meeting Extension

D. NPDES Joint Meeting Discharge Permit

E. NPDES BCSA Discharge Permit

F. NPDES BCSA Ocean Dumping Permit

G. BCSA Contract with Carlstadt

H. BCSA Contract with East Rutherford

I. BCSA Contract with Rutherford

J. EPA User Charge and Industrial Cost Recovery Requirements

K. New Jersey Surface Water Quality Standards

L. Letter from Allison C. Paulsen, Ph.D, Archaeologist

1.0 Summary, Conclusions and Recommendations

1.1 Summary

The Joint Meeting (JM) sewage treatment plant which serves portions of the Boroughs of Rutherford, East Rutherford and Carlstadt has been discharging an unsatisfactory effluent for many years. Based on reports, issued by the JM in 1966 and by the Bergen County Sewer Authority (BCSA) in 1971 and 1973, the State and Federal authorities concurred that the BCSA should construct a pumping station and force main, to transfer the JM flow to the BCSA system. The current National Pollution Discharge Elimination System (NPDES) permit for the JM plant requires the permittee to discontinue operation by connecting to the regional BCSA system.

This Facilities Plan discusses the natural, utility, and demographic systems which may affect, or be affected by, the recommended project. The projection of increasing flows, from the JM service area directly affects the project design. The report includes an Infiltration/Inflow analysis of the 46 miles of sewers tributary to the proposed JM pumping station.

Alternate schemes for treating and transporting sewage generated in the Joint Meeting area were considered. The report identifies the environmental, organizational, economic or legal factors which led to the preferred alternate selection. Preliminary design and layout of the recommended pump station and force main are presented. The project costs, method of financing, and schedule of implementation are also developed.

1.2 Conclusions

1. This Facility Plan concludes that the BCSA should construct a pumping station and force main to transfer sewage from the JM service area to the BCSA plant. This construction was evaluated to be the most economical and environmentally sound method of complying with the NPDES directive to discontinue operation of the JM plant and join the BCSA regional system. The pumping station would be constructed in the vacant northern corner of the JM plant site. Its ultimate peak capacity would be 17.5 mgd. The proposed 27 inch force main would extend approximately 9900 feet to the existing 36 inch BCSA East Rutherford Extension force main in Carlstadt.

2. This Facility Plan which includes an Infiltration/ Inflow (I/I) analysis was prepared so that the Joint Meeting Extension Project would be eligible for Federal Funding. The estimated cost of the Facility Plan, and I/I Analysis and the proposed Physical Survey phase of the Sewer System Evaluation Survey (SSES) is about $365,000 of which $273,750 may be eligible for a Federal Step I Grant.

3. The final design of the Joint Meeting Extension (JME) and the subsequent phases of the SSES would cost about $785,000 of which 75 percent may be eligible for a Federal Step II Grant.

4. The proposed construction will cost about $5,240,000 with 75 percent of the expense eligible for a Federal Step III Grant. This cost does not include the cost of sewer system rehabilitation recommended in the SSES report.

5. Accordingly, the estimated total cost for the proposed project is about $6,390,000 of which 75 percent would be eligible for a Federal Grant. These costs include allowance for inflation anticipated during the scheduled design and construction period.

6. The pumping station should be operational by 1981.

7. The construction and operation of this pumping station and force main will have no permanent adverse environmental effects.

8. As discussed in section 4.3.9 of this report, infiltration and inflow in the sewers tributary to the proposed Joint Meeting Extension appear excessive and require further evaluation.

1.3 Recommendations

1. The proposed pumping station and force main should be constructed.

2. To obtain Federal Funds, applications for a Step II Grant should be submitted for the design of the pumping station and force main, after approval of this Facility Plan.

3. After the Step II Grant is approved, the Authority should proceed immediately with design of the proposed facilities.

4. Upon completion of the design phase, a Step III Grant Application should be submitted. After approval bidding and construction should commence.

5. The first phases of the recommended Sewer System Evaluation Survey, (SSES) the physical survey and inflow investigations should be conducted. This program, detailed in Section 4.3.9, consists of physically inspecting manholes on 22.3 miles of sewer and smoke testing the entire 46 mile system. The further SSES phases and any sewer system rehabilitation, determined to be cost effective should be conducted concurrently with the design and construction of the pumping station and force main.

2.0 Introduction

2.1 Study Purpose and Scope

This study is as prepared to satisfy the Federal regulations engendered by Public Law 92.500, (1972 Amendments of the Water Pollution Control Act). These regulations require the planning agent for any project seeking Federal Grants to prepare a Facility Plan in accordance with United States Environmental Protection Agency (EPA) guidelines. Since the proposed Joint Meeting Extension project (JME) is eligible for substantial Federal Grants, the BCSA has authorized the preparation of such a Facility Plan. The scope of this report, as defined in Section 1.1, conforms to present EPA guidelines.

Facility Planning for the JME project started in 1965. Several projects report were completed before the present EPA regulations were established. These reports are subsequently described in this section. This Facility Plan supported by the previous reports fully complies with current regulations.

In 1965 the Joint Meeting authorized the preparation of a report on the feasibility of upgrading its treatment plant or connecting to the BCSA system. The report concluded that without large grants, rehabilitation of the plant would be the more expensive alternate. The JM and the individual municipalities conducted further studies to evaluate various sewage treatment alternates. Conferences were held with representatives of the BCSA, the JM and the municipalities. From these studies and conferences, the BCSA, as part of its overall planning, began planning an extension of its system to serve the JM service area. In 1971, the BCSA issued a report defining three schemes for conveying the JM sewage to the BCSA plant. In 1973, the BCSA issued a subsequent report describing the preferred alternate route. The 1966, 1971 and 1973 project reports are presented as Appendices A, B and C. Based on the BCSA reports and the NPDES directive, the Boroughs of Carlstadt, East Rutherford and Rutherford have agreed to have their sewage from the JM service area treated at the BCSA Plant. The BCSA contracts with the three municipalities are presented as Appendices G, H and I.

2.2 Planning Area

The planning area consists of the JM service area 3-1/2 square miles in Southern Bergen County, New Jersey. This area consists of the western portion of the Borough of Carlstadt, the central portion of the Borough of East Rutherford and the eastern portion of the Borough of Rutherford. The conclusions of this report affect the larger BCSA planning area. This Sewer District consists of the 50 Bergen County municipalities partially or wholly tributary to the Hackensack River. A detailed discussion of the planning area is presented in Section 4.1. Plates 1 and 2 delineate the service area. Plates 3 through 7 illustrate the characteristics of the service area including drainage, population, topography, contours and the sanitary sewer system.

3.0 Effluent Limitations

The present NPDES permit for the JM treatment plant directs the Joint Meeting to connect to the BCSA system and to abandon their facility. Since the proposed project will convey flow to the BCSA treatment plant, the effluent limitations of that Facility become pertinent. At present, the BCSA plant complies with the limitations established in the BCSA discharge and Ocean Dumping Permits. Construction to expand the plant is in progress. Upon completion, the increased capacity will be 75 mgd. The discharge permit for the Joint Meeting plant and the discharge and Ocean Dumping Permits for the BCSA plant are included as Appendices D, E and F.

4.0 Current Situation

4.1 Conditions in Planning Area

4.1.1 Planning Area Description

4.1.11 Location - The Joint Meeting service area encompasses, 3-1/2 square miles in Southern Bergen County, northeastern New Jersey eight miles west of midtown Manhattan. As shown on Plate 2, the area includes portions of three Boroughs, western Carlstadt, central East Rutherford and eastern Rutherford. The service area is mainly within the Hackensack River Drainage Basin. It is bounded by Lyndhurst on the south, the meadowlands portions of Carlstadt and East Rutherford on the east, and Wood-Ridge on the north. Wallington and the sections of Rutherford and East Rutherford, which drain to the Passaic River, lie to the west.

4.1.12 Drainage - Most of the service area drains to the Hackensack River through Berry's Creek and its tributaries. The exception is the northwest corner which drains to the Passaic River. Plate 3 indicates the area which drains into these and adjacent watersheds. The active and abandoned sewage treatment plants in the adjacent area are also presented on Plate 3.

Each municipality has an independent storm drainage system maintained by the Department of Public Works, which discharges to these streams. A significant portion of the pollution in these waterways originates from stormwater runoff.

Berry's Creek - The Berry's Creek drainage area encompasses portions of eleven Bergen County municipalities including most of the JM service area. Berry's Creek drains the service area southeastward through the meadowlands to the Hackensack River at the Rutherford-Lyndhurst boundary. Peach Island Creek and other minor creeks and drainage ditches are also tributary to Berry's Creek.

Berry's Creek has a second outlet, Berry's Creek Canal which drains southeastward to the Hackensack River along the Erie-Lackawanna Railroad tracks. Flow from the creek is diverted to the canal, near the Rutherford-East Rutherford boundary, one mile west of the Hackensack River. The canal was developed when the railroad was constructed through the meadowlands. From these two outlets Berry's Creek and the tributary East and West Riser Ditches, meander northward across the N.J. Turnpike, the Erie-Lackawanna Railroad tracks and Routes 3, 20 and 46 to their origins in Teterboro.

Two sewage treatment plants serving portions of four municipalities discharge to Berry's Creek. Wood-Ridge maintains its own treatment facility which discharges to the West Riser Ditch. Parts of Rutherford, East Rutherford and Carlstadt, are sewered to the Joint Meeting treatment plant which discharges to Berry's Creek in Rutherford.

The total average Berry's Creek flow at N.J. Rte. 3, is estimated at 13.1 mgd. The average discharge from Berry's Creek due to precipitation is 6.4 mgd at N.J. Route 3. Runoff from the N.J. Sports Complex contributes approximately ten percent of this flow. Another 4.4 mgd enters the creek from the municipal sewage treatment plants (3.7 mgd - Joint Meeting; 0.7 mgd - Wood-Ridge). Additionally, a number of industries in the watershed discharge approximately 2.5 mgd of industrial wastewater to the creek.

4.1.13 Topography - On a map, the service area has the shape of a rectangle with a tail extending from the southeastern corner. The rectangular segment averages about one mile from east to west and 2.5 miles from north to south. The tail, comprising the easternmost portion of Rutherford, is a quarter mile wide and extends approximately two miles southward.

The major portion of the service area is on the eastern slope of the Hackensack-Passaic River drainage divide. This portion drains eastward to Berry's Creek and its tributaries. The eastern edge of the service area is in the Hackensack meadowlands. Elevation contours in and adjacent to the service area are shown on Plate 4.

East of Route 17, the terrain is tidal and flat with elevations only a few feet above sea level (mean sea level - U.S. Geological Survey). West of Route 17 the topography rises to a ridgetop with elevations above 200 feet along Carlstadt's northern boundary and above 120 feet in Rutherford. Elevations along the ridge descend to 60 feet at a gap along the Erie-Lackawanna Railroad track, on the Rutherford-East Rutherford boundary. The central portion of the service area drains to Berry's Creek through the swale along this boundary. A saddle along the western boundary of Carlstadt splits the drainage of western Carlstadt between Berry's Creek through the central drainage gap and the Passaic River.

4.1.14 Geology - The service area lies entirely within New Jersey's Piedmont Plateau physiographic province. The area's surface soils were deposited by the advance and recession of the Wisconsin Glacier, which at its peak extended about 25 miles south of the service area. This glacial movement created most of the present surface topography. The JM area is divided into two distinct geological sections, the meadowlands and the ridge. Route 17 serves as the dividing line with the meadowlands to the east and the ridge to the west.

The meadowlands section is a marine tidal marsh underlain by a succession of marine, fresh water and glacial deposits. The original elevations along Route 17 were raised by layers of landfill. Bedrock is a soft red shale with occasional interbeds of fine grained sandstone (Brunswick Formation, Late Triassic). The depth to bedrock is about 130 feet below sea level near Route 3 and Berry's Creek. Glacial till from the Pleistocene Age overlies the bedrock throughout the area. The thickness of this layer ranges from 5 to 20 feet. The till consists of fragments that range in diameter from greater than 12 inches (boulder size) to less than 0.004 millimeters (clay size). Much of the till material was derived from the Brunswick Formation. Water-saturated varved silts and clays of the Pleistocene Age overlie the glacial till. This bed of nearly impermeable material reaches a thickness of 110 feet in areas. The upper surface of this layer is about 3 feet below sea level. A thin layer (0-5.5 feet) of gray, medium to fine sand overlies the varved material. The uppermost layer of material meadow mat is a mixture of decomposed and partially decomposed organic matter. Generally, the top of this mat consists of the decomposed leaves from common reedgrass while the lower portion consists of decomposed conifer forest material or peat. The entire mat ranges in thickness from 0-8 feet.

The ridge section of the service area lies on the east slope of the Hackensack-Passaic River drainage divide. Bedrock in this section is normally red sandstone or shale, as is typical of Bergen County. The depth to bedrock is normally greater than 10 feet and often greater than 40 feet. Only in a small section of Carlstadt, along the ridgetop is bedrock less than six feet below the surface. Glacial till in the ridge section is intermingled with, or overlies local deposits of stratified drift. Overlying soils are normally unassorted and heterogeneous. They include intermixed soil fractions which range in size from clay to gravel, cobble, and boulder. Silt and sand sizes predominate. Lenses and pockets of silt are frequent. Sandstone particles, derived from nearby consolidated rock formations, are the major constituents of the formation.

The highly compressible silty clay and organic soils in the meadowland section and along Route 17 is poorly drained. The glacial moraine predominating in the ridge section has fair to excellent drainage characteristics. The soil in the valley along Carlstadt's western boundary, is a porous recent alluvium with poor drainage characteristics. Plate 5 shows the subsurface and soil drainage conditions.

4.1.15 Climate - The average temperature in the area is $53^{o}F$ with monthly averages varying between $75^{o}F$ and $32^{o}F$. Extreme temperatures vary 40^{o} from the monthly average during the winter and 30^{o} from average in the summer. Extreme temperatures are somewhat moderated by the proximity of the Atlantic Ocean. The nearness of the ocean and the low lying topography often cause relatively high humidity.

The long-term annual precipitation recorded at the New Milford Gauge, seven miles north of the JM service area is 43.0 inches. Precipitation is fairly well distributed throughout the year with slightly higher amounts during the summer months. Snow comprises about five percent of the total precipitation and is a relatively minor factor in the hydrologic cycle. As precipitation, inflow and infiltration, are directly interrelated, the patterns of precipitation will be more fully discussed in subsequent sections of this report.

The prevailing winds are from the northwest during the winter and from the southwest during the summer. The area is sometimes subject to deteriorating tropical hurricanes moving northward along the eastern seaboard. These storms normally occur from mid-June to mid-October, and are most common during August and September. While it is rare for the area to be buffeted with the full 75 mile per hour winds associated with these storms, it is not uncommon for the torrential rains surrounding the storms to drench the area. The six to 24 hour rainfalls associated with deteriorating hurricanes are generally the highest which can be anticipated. Such storms can be expected every two to three years on an average, however, two or three tropical storms have occurred during the same year.

4.1.2 Organizational Context

4.1.21 Bergen County Sewer Authority (BCSA) - In the mid 1940's more than 25 municipal sewage treatment plants in

Bergen County discharged to the Hackensack River and its tributaries. Most of these plants did not provide adequate treatment to the rapidly increasing sewage flows. In 1947 the BCSA was formed to provide the option of a regional treatment facility for the 50 Bergen County municipalities within the Hackensack River watershed. The Authority constructed a secondary sewage treatment plant in Little Ferry along with trunk sewers and interceptors to convey sewage from the municipalities in the district with inadequate plants or developing sewer systems. Service was provided to Overpeck Valley in 1949, Hackensack Valley in 1960, Pascack Valley and the area southwest of Little Ferry in the late 1960's, and Northern Valley in the early 1970's. The regional plant is now being expanded to provide a treatment capacity for an average flow, of 75 mgd.

Approximately 500,000 residents in 43 municipalities are now served by the Authority. With construction of the proposed project the Joint Meeting area will become a part of the BCSA. The proposed pumping station and force main will convey sewage to the existing BCSA system. By this extension, the Authority will provide service to an additional 22,500 residents.

4.1.22 Joint Meeting (JM) - Because of increasing pollution, the State Health Department, in 1936, directed municipalities to provide secondary treatment for sewage discharged to the Hackensack River and its tributaries. Carlstadt, East Rutherford and Rutherford decided a regional solution would be most economical and formed the Rutherford-East Rutherford-Carlstadt Joint Meeting Sewer Authority (JM) in 1938. The JM was empowered to finance, construct, administer and maintain a treatment plant and the trunk sewers necessary to convey sewage from the municipalities to the plant.

4.1.3 Demographics and Land Use

4.1.31 Population - The present population of Carlstadt, East Rutherford and Rutherford is estimated at 36,000 with 22,500 sewered to the Joint Meeting system. Plate 6 graphically illustrates the past and projected growth for the Joint Meeting portions of each of the three municipalities.

4.1.32 Growth Patterns - The JM service area's most rapid growth occurred between 1900 and 1930. During these 30 years the population increased from 3,000 to 16,000, from less than fifteen to more than seventy percent of the present population. Much of the early residential development occurred as closely spaced one and two family housing.

4.1.33 Socio-Economics

Population Density - Bergen County, centrally located within the New York metropolitan region, has a relatively high development density. The developed residential portions of Carlstadt, East Rutherford and Rutherford within the JM service area, have a population density of about 15,000 residents per square mile. This density is significantly higher than the county average. At the time of the 1970 census the average household size for the JM area was about 3.0 persons/dwelling unit.

Race and Age - The population of the service area is predominately white. In 1970 blacks comprised about three percent of the residents in Rutherford and East Rutherford and less than one percent in Carlstadt. Other groups comprised only a small percentage of the population in each municipality.

and less than one percent in Carlstadt. Other groups comprised only a small percentage of the population in each municipality.

The age distribution of residents in the area is hourglass in shape with large bulges in the teens and over fifty groups. The smallest groups consist of the pre-school age and 30-40 year olds. In 1970 the percent of school age children in Rutherford and Carlstadt was about the same as the county average. The percentage of school age children in East Rutherford was below the county average. The percentage of senior citizens in all three municipalities was well above the county average.

Employment - in 1970, about 50 percent of the workers living in these three municipalities worked in Bergen County. Most of the remainder of the area work force commuted to either Passaic, Hudson or Essex Counties or New York City. A majority of the residents are employed in either "Blue Collar" or clerical jobs. However, a significant portion of the labor force is classified as professional or managerial.

Income - Bergen County is one of the nation's more affluent areas. In 1970 the median family income in both Carlstadt and East Rutherford was about equal to the state average but below the county average. In Rutherford the income level was about equal to the county average.

4.1.34 Zoning and Existing Land Use - In July 1975, the Bergen County Planning Board issued a composite zoning map for the entire county. Table 1, developed from this map, lists by municipality the various zones and corresponding acreages. At present, most residential development is closely spaced one and two family housing with several areas of garden apartments or townhouses. Commercial and light industrial areas are evenly distributed within the three municipalities while heavy industry is confined to Carlstadt.

The development of the eastern portion of the service area is now under the jurisdiction of the Hackensack Meadowlands Development Commission. A portion of the area has been set aside as open space and wetland preserves. Major development, including high rise apartments and Berry's Creek Center is proposed for the undeveloped area in eastern Rutherford. Recently the Borough of Rutherford proposed changing the zoning of the high rise district to a convention center. Hearings are presently underway.

Transportation - The private automobile is by far the predominant form of transportation in the service area. In 1970, ninety percent of the households in the service area had access to at least one automobile. Thirty Five percent had more than one car. In all likelihood this percent is higher in 1977.

The main north-south highways serving the region are Route I-95 (the N.J. Turnpike) and State Routes 17 and 21. The main east-west highways are Routes 3, 20, 46 and I-80. A study of southwestern Bergen County transportation statistics indicates that about 75 percent of the area's residents used the automobile to travel to their place of employment while 13 percent used buses and only two percent used the commuter railroad. The railroads serving the area are used mainly for freight.

Teterboro Airport, a major commercial airport, is a few miles north of the service area in the Boroughs of Teterboro and Moonachie. Flights from the three major metropolitan airports, Newark, LaGuardia and Kennedy, pass over the area.

Commercial Centers - During the past 20 years, the Borough of Paramus, six miles north of the Joint Meeting service area, has developed as the main commercial center of Bergen County, eclipsing the previous commercial dominance of the area by Paterson, Newark, downtown Hackensack and Manhattan. Major shopping centers line the two highways of Paramus, Routes 4 and 17, with nearly every major New York chain store represented. Within the service area commercial establishments have developed along Route 17 and other major municipal thoroughfares.

Institutions - The Rutherford campus of Fairleigh Dickinson University is directly west of the service area boundary at Montross Avenue. Rutherford and Saint Mary's High Schools, in Rutherford, and Becton Regional High School, in East Rutherford, are also within the service area.

Industry - Most industrial development has occurred in the Meadowlands portion of the service area east of Route 17. Other industrial zones developed along Carlstadt's western boundary and along the Erie-Lackawanna Railroad on the East Rutherford-Rutherford boundary.

4.1.4. Water Quality and Uses

The NJDEP has established water quality standards for the Hackensack River and its tributaries. Berry's Creek, into which the Joint Meeting plant discharges and the Hackensack River between Berry's and Overpeck Creeks into which the Authority treatment plant discharges are classified as TW-2. The definition of this standard is:

"Tidal waters approved as sources of public water supply after such treatment as shall be required by law or regulation.

These waters shall also be suitable for secondary contact recreation; the propagation and maintenance of fish populations; the migration of anadromous fish; the maintenance of wildlife and other reasonable uses."

The water quality standards for this classification are described in the August 1, 1975 New Jersey Surface Water Quality Standards presented as Appendix K.

The Hackensack River, downstream of Berry's Creek is classified TW-3. This classification states:

"Tidal waters suitable for secondary contact recreation; the maintenance of fish populations; the migration of anadromous fish; the maintenance of wildlife and other reasonable uses."

The water quality standards for this classification are also described in the New Jersey Surface Water Quality Standards (Appendix K).

As established in Section 303(e) of the Water Quality Management Basin Plan, Northeast New Jersey Urban Area, August, 1975, the NJDEP considers the quality of these waters as "Water Quality Limited". The "Water Quality Limited" designation is applied to any segment of the waterway in which the water quality does not meet applicable standards and is not expected to meet applicable standards even after "best practicable treatment" to the point source effluents within the segment are achieved. Water Quality Limited segments require a greater effort in determining the level of detail necessary for pollution abatement investigations.

The poorest Hackensack River water quality occurs slightly north of Overpeck Creek to slightly south of Berry's Creek. Low dissolved oxygen profiles are typical in the section between these two creeks. Dissolved oxygen concentrations often fall below those standards set by the NJDEP in their classification of TW-2 for this reach of the river. Five-day BOD, organic nitrogen, and phosphorus levels are also high in the section between Overpeck Creek and Berry's Creek.

The NJDEP classified the waters of Berry's Creek as TW-2. Water quality in the Creek is variable and frequently does not meet the current water quality standards. Five-day BOD, nutrient concentrations, and coliform counts are very high. Oil and grease slicks are routinely observed. Dissolved oxygen is absent from the water for several days each month.

In 1973-74, Jack McCormick and Associates, Inc. conducted a water quality surveillance program of Berry's Creek. This study indicated that BOD, metals, and bacteria originate from discharges upstream of the sports complex site. Analysis of nitrogen data shows organic nitrogen decreasing and ammonia nitrogen increasing in the downstream direction. This indicates that nutrients discharge upstream of the sports complex. Oil and grease discharges originate from inactive landfill sites in the area.

Significant levels of mercury contamination were observed in the creek waters in 1974 shortly after demolition of a factory upstream of Paterson Plank Road. Soils on the factory site appeared saturated with a mercury-containing oil. Mercury laden leachate from this site may enter the creek for several decades. Marsh sediment samples were taken in areas adjacent to the creek in 1972. Concentrations of mercury in the samples were unusually high. Samples taken again in 1974 verified these findings. These marsh sediment samples contained mercury concentrations ranging from 40 to 4,000 times higher than anticipated.

These industries have applied for NPDES permits to discharge to Berry's Creek:

Becton, Dickinson - East Rutherford
Diamond Shamrock Corp. - Carlstadt
Tanatex Chem. - Lyndhurst
Yoo-Hoo Beverage - Carlstadt
Howmedica Inc. - Rutherford
U.S. Printing Ink - East Rutherford
Carmet Co. - East Rutherford
Refined Onyx Div. of Miumaster - Lyndhurst
Technical Oil Products Inc. - Carlstadt
Marathon Enterprises, Inc. - East Rutherford

Details of the nature of the discharges can be reviewed at the Region II Office of the U.S. EPA, 26 Federal Plaza, New York, N.Y.

Some industries within the service area maintain private wells. Most of this water is used in manufacturing and cooling processes and is discharged to the local storm sewer system. Wells owned by private citizens are used mostly for lawn and garden watering.

4.1.5 Flora and Fauna

4.1.51 Flora - Two groups of vegetation are found in the project area; that typical of the Hackensack Meadowlands, and that typical of the ridges and hills of northeastern New Jersey.

Vegetation in the meadowlands consists mainly of common reedgrass (Phragmites). Stands of reedgrass, 8 to 10 feet high, cover most of the area. The stands are generally pure growths of common reed (*Phragmites communis* or *P. australis*). These stands are subject to diurnal variations caused by the tides. In many areas, particularly on the edges of filled lands, the reeds are shorter, from 4 to 8 feet, and have a mixed undergrowth of ragweed, nightshade, pokeweed, goldenrod, pigweed, bindweed, blackberry, thistle, and various grasses and sedges. Elderberry, quaking aspen and tree-of-heaven are also found in a few upland reed areas. Open water, barren land or industrial zones cover much of the project area. Open waters, such as channels and mudflats are virtually devoid of rooted plants. Mats of blue-green algae cover a number of mudflats. The water surface in many of the shallow ditches and puddles in the non-tidal areas is covered with duckweed. Cordgrass, salt reed grass, water hemp and narrow leaved cattail are in small isolated stands adjacent to larger marsh channels. Marshmallow is a common shrub-form herb along the banks and in shallow sections of ditches.

Landscaped roadsides and mowed lawns have areas of bluegrass, fescue grass, white campion, red clover and white clover.

West of Route 17, as the land rises from the meadowlands, a different type of vegetation is found. Most of this section is highly developed and the vegetation is typical of high density urban areas in northeastern New Jersey.

4.1.52 <u>Fauna</u> - Different types of animal life are found in the meadowlands and upland sections of the project area.

Wildlife in the meadowlands sections of the project area is typical of wildlife throughout the Hackensack Meadowlands. Birds, mammals, amphibians and reptiles frequent the marshes in the project area.

Several bird species breed in the marsh areas including mallard, black duck, blue winged teal, common gallinule and ring-necked pheasant. Green heron, black-crowned night heron and king rail may visit or inhabit the area. Spotted sandpipers breed near mudflats along ditches. Numerous other species of songbirds breed in the area.

Several different types of mammals occupy the meadowlands despite pollution and industrial development. These include the house mouse, muskrat, Norway rat and long tailed weasel. The house mouse generally does not abide in the tidal marsh areas but is common along the edges of the marsh and in developed areas of the meadowlands.

Rabbits are reported to be common in landfill habitats and other drier portions of the meadowlands. Opossum, striped skunk and raccoon are also found in the drier areas. Several species of animals generally uncommon to polluted or developed areas, are still occasionally found. These include the gray fox, red fox and long tailed weasel. Wild dogs and feral house cats also are reported to visit the meadowland area.

Northern leopard frogs and painted turtles inhabit non-tidal portions of the marsh. Snapping turtles are common in the diked and tidal marshes. The eastern garter snake is also common near the project area.

Animal life in the upland region of the project area, west of Route 17, is typical of animal life in the highly urbanized sections of the northern metropolitan area.

These endangered species, as listed by the NJDEP dated January 8, 1975, or in the Federal Register, August 25, 1970, have been observed near the study area:

1. the American Peregrine (Falco peregrinus);
2. the American Bald Eagle (Hilliaetus esucocophalis);
3. The Osprey (Pandion haleaetus); and
4. Cooper's Hawk (Accepiter cooperii).

4.1.6. Air Quality

Air quality measurements have been conducted near the service area by the NJDEP. These measurements obtained at the Hackensack Monitoring Station during 1975.

Carbon Monoxide:

1 hour Average (maximum)	= 15.2 ppm
1 hour Primary and Secondary standard	= 35 ppm
Number of times 1 hour standard was exceeded	= 0
8 hour Average (maximum)	= 10.2 ppm
8 hour Primary and Secondary standard	= 9 ppm
Number of times 8 hour standard was exceeded	= 7

Sulfur Dioxide:

3 hour Average (maximum)	= 0.085 ppm
3 hour Secondary standard	= 0.5 ppm
Number of times 3 hour standard was exceeded	= 0
24 hour Average (maximum)	= 0.049 ppm
24 hour Primary standard	= 0.14 ppm
Number of times Primary standard was exceeded	= 0
24 hour Secondary standard	= 0.10 ppm
Number of times Secondary standard was exceeded	= 0
12 Month Average	= 0.009 ppm
12 Month Primary standard	= 0.03 ppm
12 Month Secondary standard	= 0.02 ppm

Smoke Shade

24 hour Average (maximum)	= 2.66 ppm
Annual Average (COHS)*	= 0.86 ppm

*Coefficient of haze per 1,000 lineal feet.

4.1.7. Historic and Archaeological Sites An archaeological survey was conducted by, Allison C. Paulsen Phd, a certified archaeologist. No sites of significant historic or archaeological importance were reported within the project area. A letter indicating the results of the survey is presented as Appendix L.

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4.1.8 Noise

Most noise originates from the transportation facilities. Due to the large amount of car and truck traffic on the highways and roads, noise levels are high. State Highway 17 and Paterson Plank Road are major access roads for the industrial areas and carry a large quantity of truck traffic. The traffic rate on Route 17 reaches 1,300 to 1,900 vehicles per hour on weekdays, often resulting in unacceptably high noise levels. Vehicular traffic on Paterson Plank Road ranges from 440 to 1,000 vehicles per hour on weekdays. Noise levels range from acceptable to unacceptable. Traffic on other major highways does not normally affect noise level.

Both Newark and Teterboro Airports have flight patterns over the project area. Air traffic noise is an important consideration, especially when vehicular traffic is at a minimum. Noise levels due to air traffic are often unacceptable in parts of the Service Area.

Railroads raise the noise levels in areas adjacent to the rights-of-way. This is significant where the tracks traverse the service area.

The noise generated by air, highway and railroad traffic generally creates an unsatisfactory noise environment for people living and working within the service area.

4.1.9 Environmentally Sensitive Areas

The meadowlands portion of the project area is environmentally sensitive, and "intolerant of major changes by man". Sensitive areas normally include fresh and salt water ponds, marshes and wetlands, dunes and bluffs, and coastal zones. Also included are areas with impermeable soils, areas with slopes greater than 15 percent, areas with high groundwater tables, and areas favorable for groundwater supply. The section of the meadowlands in which the project will be constructed falls into the marshes and wetlands category, however, because of past industrial development, the environment's sensitivity is limited.

4.2 Existing Wastewater Flows and Treatment System

4.2.1 Bergen County Sewer Authority Treatment Plant

The Bergen County Sewer Authority's plant provides secondary treatment by contact-stabilization with step aeration. After passing through screens, pumps, grit chambers and primary settling tanks, the sewage is mixed with sludge which has been aerated for several hours and the mixture is aerated for a short contact period. The mixed liquor then flows to secondary clarifiers to settle the solids. The clarified effluent flows through chlorine contact tacks and outfall sewers to the Hackensack River. A portion of the settled secondary sludge is returned to the aeration tanks. The remaining sludge, in excess of the volume required for the aeration process, is mixed with primary settled sludge, thickened, anaerobically digested and barged to sea.

Plate 1 shows the BCSA plant in Little Ferry, the proposed Joint Meeting Extension pumping station and the force main which will connect the JM service area to the Authority system.

4.2.2 Joint Meeting Extension Pumping Station and Force Main

The proposed project, to allow the abandonment of the Joint Meeting treatment plant, includes construction of a 17.5 mgd pumping facility and 27 inch force main which will connect the station with the East Rutherford Extension force main. Plate 2 shows the selected route of the force main. The pumping station will be constructed in the northwest corner of the existing plant site near the trickling filters. A detailed description of the station, force main and anticipated flows are included in section 8.1 of this report.

4.2.3 Existing Joint Meeting Treatment Plant

The Joint Meeting treatment plant was constructed in 1939-1940 in Rutherford, along the East Rutherford boundary, east of Route 17. Two miles of intercepting sewers were also constructed at that time. The facilities were designed to treat average flows of 4.0 mgd with peak flows up to 12 mgd. Secondary treatment was provided by routing the wastewater through these units:

1. Bar Screens
2. Grit Collectors
3. Coagulation Basins
4. Primary Settling Tanks

5. Trickling Filters
6. Secondary Settling Tanks
7. Magnetite Sand Filter
8. Chlorine Contact Tank

The plant was designed to dispose of sludge by two stage digestion and incineration.

The location of present treatment facility is shown on Plates 2 and 14. Plate 7 shows a general layout of the trunk system while Plate 14 gives a detailed layout of all sewers within the service area.

4.2.4 Base Sanitary Sewage

The average base domestic and industrial sewage for each municipal subdivison (minisystem) and the total service area was determined mainly by analysis of the 1974 water consumption records provided by the Hackensack Water Company. The utility provided the survey with a record of the water purchased by each customer during the calendar year, based on individual meter readings. Each customer's water consumption was allocated to its proper municipal minisystem. These figures were checked against the population in each minisystem as determined from the corrected U.S. 1970 census.

The present base sewage flow from the service area was computed at 2.37 mgd, of which 1.59 mgd is domestic and 0.78 mgd is industrial. Table 2 summarizes the present average domestic and industrial flows from Rutherford, East Rutherford and Carlstadt.

4.2.41 Average Domestic Flow - In the year 1974 for the Joint Meeting service area the total domestic water consumption, including commercial and institutional use, averaged 1.67 mgd. In determining the domestic base sanitary sewage flow, the estimated water not discharged to the sanitary system was deducted from the total consumption.

The quantity of domestic water consumption not discharged to the sewer system is primarily that portion used for lawn and garden watering. For the BCSA Sewer System Evaluation, the Hackensack Water Company provided tri-monthly records of total consumption by municipality. By comparing the additional use in summer, water consumption not reflected in sewage flows, and the difference in consumption between years with wet and dry summers, these points became evident:

(1) External water consumption is roughly proportional to the developed land area.

(2) Annual average external water use will vary between 15,000 gpd per square mile in a year with a wet spring and summer to 35,000 gpd per square mile in a year with a dry spring and summer.

Since the 1974 growing season was fairly dry, an allowance for external use of 30,000 gpd per square mile was used over the 2.65 square mile developed service area, or 0.08 mgd. Subtracting this external use from the total domestic consumption, 1.67 mgd yields a domestic basic sanitary sewage flow for the service area of 1.59 mgd. The distribution of the domestic base sewage by minisystem is shown on Plate 8.

4.2.42 Average Industrial Flow - The industrial sewage in 1974 averaged 0.78 mgd. Approximately 60 percent of this flow or 0.45 mgd, originated from these 13 industries, all of which discharge more than 10,000 gpd:

Company	Discharge (1000 gpd)	Municipality
1. Arcynco, Inc.	120	Carlstadt
2. RJR Archer	66	Carlstadt
3. Ganes Chemical Co.	56	Carlstadt
4. General Printing Ink Co.	35	E. Rutherford
5. Diamond Shamrock Chem.	30	Carlstadt
6. Brevel Motors Corp.	24	Carlstadt
7. Catalyst Development Corp	23	Carlstadt
8. A & M Electroplating	20	Carlstadt
9. Town Offset	19	Carlstadt
10. Aluminum Anodizing	14	Carlstadt
11. Bell Container Corp.	14	E. Rutherford
12. Insulfab Plastics Inc.	13	E. Rutherford
13. Howmedica, Inc.	12	Rutherford
	446	

The remaining 0.33 mgd originated from the additional 250 industries in the service area.

Plate 8 indicates the industrial flow from each mini-system. The majority of the industrial flow originates in the areas east of Route 17, along Carlstadt's western boundary, and along the Erie-Lackawanna Railroad at the Rutherford-East Rutherford boundary.

4.2.43 Peak Flow - Peaks of both domestic and industrial flows were estimated to be 1.5 times the average base flow. These estimates are based on the analysis of the diurnal curve for the JM treatment plant, and similar analyses for the BCSA treatment plant.

4.2.5 Patterns of Base Sanitary Flow

The section 4.2.4 developed a method for determining average base sanitary flow. This section discusses the variations from average. Three patterns were considered:

1. Minute-to-minute variation
2. Hourly variations, curves including peaks
3. Day of the week variation

4.2.51 Minute-to-Minute Fluctuation - The base sanitary flow at any point in the sewer system, is not steady, but a summation of intermittent surges. Each upstream resident independently decides when to use his toilet, sink, showers or washing machines; superimposing irregular sawtooth fluctuations on the flow pattern of the diurnal curve. Consider that a single flushed toilet will empty five gallons into the sewer in a period of ten seconds, creating a flow surge with an initial peak of over 40,000 gpd.

In the BCSA I/I analysis, a study of flow pattern recorded at several Authority meters disclosed the probable range of fluctuation due to base flow unpredictability. Fluctuation was greatest during the peak base flow periods. In small systems, the surges appear to have a minimum value of 50,000 gpd during peak periods of the day. In a system with one mgd average flow, the surging during peak periods is about fifteen percent. These surges are represented by the random sawtooth pattern superimposed on the typical daily base flow curve on Plate 9. In the hours between 3 a.m. and 6 a.m., the base flow surges are substantially less than at any other period of the day. This early morning stability may be the result of the larger percentage of the base flow originating from steadily leaking fixtures and infiltration rather than from intermittent usage.

4.2.52 Hourly Flow Variation (The Diurnal Curve) - Plate 9 shows the hourly base sanitary flow, excluding infiltration, which can be expected for the service area. The curve was constructed using plant flow records during various weekdays for the June 1974 - March 1975 study period. It should be noted that the peak value of the base flow, which occurs between 9 a.m. and 11 a.m., does not exceed 1.5 times the annual average. The minimum value occurs between 3 a.m. and 6 a.m. and generally ranges from twenty to forty percent of average.

This curve is applicable to minisystems in which the sanitary base flow is primarily domestic. Base flows from systems serving predominantly industrial areas may exhibit peaks ranging from 2 to 4 times average with a time-distribution pattern more closely following the work week.

Plate 9 shows that the difference between the flow at 6 a.m. and 12 noon generally approximates the value of the average daily base flow. This constant difference can be used to check base flow estimates, or estimate base flow where water consumption data is not available.

4.2.53 Variation by Day of Week - An analysis of two years of daily JM plant records disclosed that the base flow varied by day-of-week in this pattern:

Weekdays	108% Average
Saturdays and Minor Holidays	79% Average
Sundays and Major Holidays	75% Average

The lower weekend flows are due to the substantial lower industrial flows. There was no significant difference between total flows for each of the five weekdays.

These conditions, noted during the BCSA analysis, also apply to the Joint Meeting system:

1. Flows from predominantly residential areas were slightly higher on weekends than during the week.

2. The weekend diurnal flow pattern from predominantly residential areas reflected the pattern of later rising and retiring without the mid-afternoon slack found on weekdays.

3. Peak flows on weekends were no higher than on weekdays.

4.3 INFILTRATION/INFLOW ANALYSIS

4.3.1 Purpose and Scope

Section 201 of the 1972 Water Pollution Control Act Amendments and Section 35.927 of the Rules and Regulations of the EPA requires an Infiltration/Inflow (I/I) analysis for projects requesting Federal Grant monies. A subsequent staged Sewer System Evaluation Survey (SSES) is required if the analysis demonstrates that the sewers admit excessive Infiltration/Inflow. Excessive Infiltration /Inflow is that portion which a cost-effectiveness analysis determines as more economical to eliminate from the system than to transport and treat.

The analysis presented as Section 4.3 of the Facilities Plan discusses the tributary sewer system, extraneous flows, field investigations, the cost-effectiveness analysis and the recommended programs. Some supportive data which is usually incorporated into an independent I/I analysis is included in Sections 4.1, 4.2 and 5.0.. Other supportive data is included in the I/I analysis for the BCSA system.

4.3.2 Sewer System

4.3.21 Development - Most of the sanitary sewers in the Joint Meeting service area were constructed around 1910 by the Boroughs of Rutherford, East Rutherford and Carlstadt. Between 1910 and 1940, sewage from the three municipal sanitary sewer systems discharged to Berry's Creek after passing through rudimentary municipal sewage treatment plants. The treatment provided by these facilities was inadequate to prevent increased pollution of Berry's Creek and the Hackensack River. The pollution was compounded by the tidal action in these waterways which retards the downstream travel of the sewage pollutants.

In 1936 the State Department of Health adopted a resolution requiring secondary treatment for all sewage discharged to the Hackensack River and its tributaries. To comply with this ruling the three Boroughs decided that a single sewage treatment plant would be most feasible. Accordingly in 1938, Rutherford, East Rutherford and Carlstadt created the "Joint Meeting" empowered to construct, operate, maintain and finance a single secondary treatment plant and the trunk sewers necessary to convey sewage from the municipal systems to the plant. The Joint Meeting Treatment Plant in Rutherford and the trunk sewers were constructed as PWA projects (N.J. 1400F Contracts 1 and 2) in 1939 and 1940.

4.3.22 Description

Sewer Lengths - There are presently 46 miles of gravity sewers, excluding house connections, tributary to the Joint Meeting plant. Approximately 43.9 miles were constructed by the municipalities. The remaining 2.1 miles were constructed by the Joint Meeting. This is the sewer length distribution by municipality:

	Municipal Sewers (miles)	Joint Meeting Sewers (miles)	Total (miles)
1. Carlstadt	12.6	0.9	13.5

(Cont'd)

		(cont'd)		
2.	East Rutherford	12.2	1.2	13.4
3.	Rutherford	19.1	-	19.1
	TOTAL	43.9	2.1	46.0

In addition to the main gravity sewers, approximately 40 miles of house and building connection sewers link the estimated 5,000 buildings in the service area to the system.

Sewer Sizes - Sewers eight inches in diameter with scattered nine, ten and twelve inch diameter sewers comprise the majority of the municipal system. A few of the major municipal trunks are 15 inches or greater in diameter. Plate 14 indicates the sewer sizes of the Joint Meeting and tributary municipal sewers.

The 2.1 mile Joint meeting system includes 1.4 miles of 24-36 inch trunk sewer which extends along Route 17 from Carlstadt to the treatment plant. The other 0.7 miles of Joint Meeting sewer ranges from eight to eighteen inches in diameter and was constructed to convey sewage from sections of Carlstadt to meter chambers along the East Rutherford boundary.

House and building connection sewers are generally four or six inches in diameter.

Construction Details - In 1910, Carlstadt, East Rutherford and Rutherford constructed the ridge portion of their sewer system. The sewers constructed mainly of clay pipe with two to three-foot joint spacing. Most of these joints were packed with oakum and sealed with cement.

Sewers in the lowlands constructed during the past twenty years were generally asbestos cement pipe in 13-foot lengths or clay pipe with four to five-foot lengths. Short lengths of concrete pipe and cast iron pipe were also used. Joints on the newer sewers were generally sealed by rubber "O" or "A" ring gaskets.

Sewers owned by the Joint Meeting were constructed of virtrified clay and reinforced concrete pipe. The joints were packed with oakum and sealed with a hot poured bituminous compound.

House connections are generally clay pipe with leaded joints installed by plumbing contractors in four to five-foot laying lengths.

Brick manholes, for access and cleaning, were constructed at intersections, changes in sewer size, slope and direction. Cast iron manhole covers have both pick and vent holes. The 46 mile system now includes 1020 manholes, an average of 22 manholes per mile, or 240 feet of sewer per manhole.

When the original municipal systems were constructed, it was an accepted practice to include lampholes and flush shaft connections to the sewers. In recent years the flush shafts were disconnected, and the lampholes were paved over during roadway resurfacing.

<u>Sewage Routing</u> - Plate 7 presents the general layout of the Joint Meeting sewers,along with the municipal trunk sewers and laterals with more than ten upstream manholes. A detailed map of the entire sewer system is presented on Plate 14.

The only pumping station in the system is at the Joint Meeting treatment plant. All of the sewage is conveyed to the plant by gravity flow to the plant.

<u>Joint Meeting Metering System</u> - Five continuous flow meters were constructed to measure the sewage flow from each member municipality. Two of the meters were installed to monitor flow from Carlstadt which enters the East Rutherford municipal system. These are on Garden Street at Hoboken Road and on Union Street at Hoboken Road. The remainder of Carlstadt's flow is metered as it enters the Joint Meeting trunk sewer at Route 17 and Paterson Plank Road. Flow from East Rutherford and Carlstadt was metered on the eastern side of Route 17 near the Erie-Lackawanna Railroad tracks. Rutherford's sewage flow was metered on Borough Street east of Veterans Boulevard. These five meters have been inoperative for many years and have deteriorated.

Presently, the total sewage flow for the service area is metered continuously at the treatment plant by a 24" parshall flume downstream of the raw sewage pumps and grit chamber. The accuracy of this meter is questionable.

The daily flow recorded at the JM plant was plotted for the two-year period. There was a continuous lowering of flows through the period which was unrelated to hydrological condition or changes in base flow. When the meter was adjusted in June 1974 the recorded flow increased over 1.0 mgd and then began drifting downward. Because of this drift, caused by apparent meter inaccuracy, the JM plant flow records were not used to determine the total JM flow, except for a short period immediately after repair. Because the drift was slow, the relative diurnal variation, and the day-to-day changes recorded by the plant meter were considered valid.

4.3.23 Interview with Municipal Officials - In February and March 1976, the borough officials responsible for the operation and maintenance of each municipal sewer system were interviewed. The officials selected were the Superintendents of Public Works and the former engineers for the boroughs and the Joint Meeting. The interviewer's questions dealt with the operation, maintenance and condition of sanitary sewer system as well as local surface and groundwater conditions. Such information, usually not obtainable from maps or earlier reports, is essential for analysis of the sewer system.

Questions on operations were included to gain information on:

1. legal or illicit storm connections;
2. overflows, bypassing or interconnections;
3. the response of the system to storms.

Questions on maintenance were asked to ascertain how often the system was cleaned and by what methods.

Sewer conditions were ascertained from the questions concerning:

1. age, pipe material, joint material and venting of manhole covers;

2. structural condition of pipes and manholes;

3. specific locations and details of solids buildups, roots intrustion or structural defects.

Questions on drainage and groundwater included:

1. locations of swamps and springs;

2. areas of flooding due to inadequate drainage or tidal conditions;

3. areas where well pointing is required during excavation.

The information on groundwater conditions was incorporated on Plate 5. Much of the pertinent information from these interviews is included in section 4.3.24.

4.3.24 Present Conditions - These personnel were interviewed to determine and evaluate the condition of the sewers tributary to the Joint Meeting plant:

Rutherford

1. Superintendent of Department of Public Works
2. Former municipal engineer

East Rutherford

1. Superintendent of Department of Public Works
2. Former municipal engineer
3. Present municipal engineer

Carlstadt

1. Superintendent of Department of Public Works
2. Former municipal engineer
3. Present municipal engineer

Joint Meeting

1. Engineer

Rutherford - Vent and pick holes in the manhole covers admit inflow to the sanitary system in areas which flood during heavy rainfall or high tides. Such flooding was reported on Veteran's Boulevard and on Erie Avenue east of Chestnut Street. Possible storm connections to the sanitary system along Orient Way and at other unspecific locations may also contribute inflow. Other inflow sources include air conditioners, sump pumps and drains for roofs, yards, foundations and cellars, which may be connected to the sanitary system. The interviewed officials were not aware of the exact location of any of these sources.

In the preliminary investigations for night metering our field technicians discovered a cross connection between the storm and sanitary sewers on Erie Avenue at Chestnut Street. This cross connection apparently functions as an inflow source since the Superintendent for the D.P.W. reported that heavy rainfall surcharges the storm sewers in this area. The pressure from the surcharging occasionally lifts storm manhole covers off their rims.

Sewers in areas with a high groundwater table may contribute excessive infiltration. Reported areas with high groundwater include the swampy meadowlands, underlain by springs east of Route 17 and Springdell Avenue.

Root intrusion into the house connections along with buildups of grease and rags have caused basement backups on Orient Way near Winslow place. The root intrusion may indicate excessive infiltration.

East Rutherford - Flooding during heavy rainfall was reported on Paterson Avenue at Hoboken Avenue and on Hackensack Street at the railroad crossing. As previously mentioned, street flooding contributes inflow to the sanitary system. Specific inflow sources within the borough such as storm system cross connections, sump pumps or illegal drain connections were not reported. High groundwater east of Route 17 and springs throughout the borough indicate areas which may contribute excessive infiltration.

Carlstadt - These areas subject to flooding during extremely high tides or heavy rainfall, may contribute inflow to the Carlstadt system:

1. Broad Street between Thirteenth and Fourteenth Streets
2. Hoboken Road at Tenth and Broad Streets
3. The general area east of Route 17

Illegal drainage connections (roof, area, foundation and cellar drains) were reported on Eighth Street north of Marsan Drive. Drains may connect to the sanitary system in other areas, however, specific locations were not reported.

The area between Route 17 and Berry's Creek lies within the Hackensack Meadowlands. Excessive infiltration caused by high groundwater may occur in this section of the system. Root intrusion into the system, another indicator of excessive infiltration, was reported on Tenth Street near Division Street, and on Sixth Street between Berry Avenue and Broad Street.

4.3.25 Maintenance Program - The three service area municipalities have independent sewer maintenance programs. In general, sewers are cleaned at regular intervals, blockages and other problems are handled as they are reported. The specific program for each municipality is listed.

1. Rutherford - Bi-annually, all sewers are cleared with rodder and bucket machine. Each summer the sewers are rodded and flushed. Basement backups and blockages caused by solids or root buildup are eliminated as they occur.

2. East Rutherford - The major trunk sewers are checked daily and jetted or rodded as required. All sewers within East Rutherford are cleaned several times during the year. No root intrusion has been encountered. In the past, deposits of petroleum products, especially tar, have been traced to the Flintkote Corporation.

3. Carlstadt - Carlstadt recently purchased jetting equipment and established a regular maintenance program. This program consists of jetting all sewers within the borough and handling problems as they occur. These areas had required regular attention:

	Street	Cause of Blockage
1.	Tenth St., between Broad St. and Division St.	Detergent Accumlation
2.	Route 17, north and south of Broad St.	Age of sewer, insufficient slope

(cont'd)

(cont'd)

	Street	Cause of Blockage
3.	Sixth St., Between Berry Ave. and Broad St.	Root intrusion
4.	Fourth St. north of Broad St.	Root intrusion
5.	Broad St. at Washington St.	Solids buildup accumulation of papers and rags

These problems may be alleviated by the sewer cleaning program.

4.3.3 Infiltration

4.3.31 Introduction - The term infiltration in this report refers to ground water which enters the sewer system either through leaking pipe joints, broken and cracked pipe, or through connected soil, foundation and basement drains. There are two patterns of infiltration, rain-responsive and continous. The rain-responsive pattern exhibits higher peaks, but the continuous seepage contributes more of the total infiltration. The rate of both types of infiltration fluctuates widely in response to changing ground water conditions.

The BCSA Sewer System Evaluation in chapter five presents a detailed discussion on the types of infiltration and how they are effected by precipitation, groundwater levels and soil composition.

4.3.32 Infiltration Measurement Minisystem Infiltration Determination by Subdivision of Municipalities into Minisystem - For purposes of metering and analysis, the municipal sewer systems were subdivided into minisystems which on the average contained approximately two miles of sanitary sewer tributary to each meter point. These single letter designations were assigned to each minisystem:

MUNICIPALITY	MINISYSTEMS
Carlstadt	A to F
East Rutherford	G to L
Rutherford	M to U

Table 3 lists the tributary lengths of both municipal and Joint Meeting sewers in each minisystem. The boundary of each minisystem is shown on Plate 10.

The service area sewer system, shown on Plate 7, illustrates the interrelation of the minisystems. This plate indicates that minisystems A, B, C, D, E, F, I, M, N, P, Q, R, S, T and U were metered independently, that is, without subtracting upstream meter readings. Two of the minisystems, K and L were metered by subtracting a single upstream reading. Metering minisystems G, H, J and O required two or more subtractions. The reliability of computed minisystem rates is generally low where the flow from more than one upstream minisystem must be subtracted. In these cases, infiltration originating in the downstream minisystem is a small percentage of the measured flow. Therefore, the cumulative probable errors inherent in the flow measurements and in the base flow estimates may be greater than downstream minisystem infiltration. An effort was made to maximize the number of minisystems which could be spot metered independently. However, in minisystems G, H, J and O, the system layout precluded any alternative to several tributary minisystems.

Key Manhole Selection - The downstream boundary of each minisystem was the key manhole at which all the upstream sewage flow could be metered. Physical accessibility was one of the main considerations in the choice of key manholes. Key manholes were not selected in areas with heavy highway traffic or on property enclosed by a security fence. The presence of noxious fumes or hazardous structural conditions also prevented that manhole's selection. Often a manhole could not be used because its pipe and bench configuration prevented the installation of any portable flow meter. These unfavorable configurations are discussed in detail in the BCSA I/I analysis. The key manhole for each minisystem is shown on Plates 7 and 14.

Erroneous Maps and Flow-Splitting Manholes - In several cases the direction of flow, inferred from the sewer maps provided by the municipality required verification in the field. Preliminary plans were provided for certain areas since no as-built maps were available. In other instances, relief sewers had been constructed, which were not recorded on the map. These sewers changed the pattern of flow. Such map inaccuracies were corrected by field investigation.

Basis for Nocturnal Metering - In the hours between 3 and 6 a.m. the diurnal base flow curve, shown on Plate 9, is at its lowest and most constant value and exhibits the least minute-to-minute fluctuation. For these reasons, nocturnal spot flow measurements, conducted between 3 a.m. and 6 a.m., was made to maximize the number of minisystems which could be spot metered independently. However, in minisystems G, H, J and O, the system layout precluded any alternative to several tributary minisystems.

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In a typical minisystem the nocturnal base may comprise about half of the measured flow. The base sanitary sewage at any other time of day would comprise the majority of the measured flow. The estimate of nocturnal base flow is, at best, accurate to only ± 20 percent. At other times the base flow rate fluctuates more erratically, therefore the accuracy of the base flow estimate would be lower. The infiltration could be smaller than the probable error in the estimated base flow, rendering the computed infiltration rate highly unreliable. Base flow pattern distortions from independent upstream discharges, like flushing the toilet, become more critical in small areas where the flow is low. However, the major portion of the nocturnal base sewage is suspected to come from fixtures leaking at a constant rate, stabilizing the flow pattern. Spot measurements at key manholes were always taken at least twice a night and at least one hour apart. These readings were averaged to minimize error caused by minute-to-minute fluctuation.

Spot Flow Metering - Out of the many schemes of flow measurement investigated for the BCSA survey, four methods of spot metering the nocturnal sewage flow were found economical, practical and reasonably accurate. These four methods are, in order of preference:

1. weir discs
2. portable flumes
3. weir boxes
4. area velocity measurements.

Each of these methods can be used for a limited flow range and in a manhole with a compatible configuration. With the flow conditions and manhole configurations encountered in the Joint Meeting service area, only the weir disc and area velocity measurement methods were used for flow measurement.

The use of the weir disc was limited by its low measurement capacity, however, at seven metering points they were used satisfactorily. Area-velocity measurements were used to determine flows in 14 minisystems.

Section 6.3.4 of the BCSA Sewer System Evaluation Report contains a detailed discussion of night metering and field procedures including the use of weir discs and area velocity measurements. The advantages and limitations of each technique are also discussed.

<u>Groundwater Probes</u> - To determine the groundwater conditions at the time of the spot metering, in accordance with Environmental Protection Agency Guidelines, groundwater probes were installed in most key minisystem manholes. Exceptions were:

1. key manholes in areas of heavy traffic

(cont'd)

(cont'd)

2. key manholes adjacent to another manhole with a probe
3. key manholes with noxious odors
4. a very shallow key manhole

For additional information concerning the design and installation of groundwater probes refer to the BCSA Infiltration/Inflow and Physical Survey Report, Section 6.4.1.

A total of 19 groundwater probes were installed during February 1976. These probes were monitored each night the minisystem flows were metered. The probes were also monitored after major rainfalls.

Plate 11 shows the locations and depths of these probes. This plate also summarizes the range of groundwater depths recorded at each probe. In most of the key manholes the groundwater level was always below the probe base. Manholes with higher groundwater levels were observed at low ground elevations and along natural drainage channels.

The use of probe readings to correlate infiltration with groundwater levels had limited value in developing the conclusion of this report. The rolling topography in most minisystems of the service area, generally produces highly non-uniform groundwater depths. The key manhole is by definition at the lowest elevation in the minisystem, and therefore, more likely to exhibit a high groundwater level. However, it is unlikely that the groundwater level at the key manhole is representative of groundwater conditions for the entire minisystem.

An analysis of the probe data did indicate that, during average conditions, more than 90 percent of the sewers are above the groundwater level. Even during high infiltration periods, more than 75 percent of the sewers are probably above the water table.

Adjustment of Minisystem Infiltration to Average Conditions - The subsurface and topographic conditions in the JM service area are typical of the conditions throughout the BSCA service area. The majority of sewers are in glacial moraine in undulating terrain, with a sizable minority in low-lying swampy areas. There is no significant difference in precipitation between the areas. Based on these similarities, much of the data and conclusions concerning the patterns of infiltration/inflow developed for the BCSA I/I analysis are applicable to the JM system.

In most BCSA meter areas the infiltration rate exhibited high fluctuation in response to seasonal conditions and antecedent precipitation. Because of this fluctuation, it was determined that a single spot measurement would not be sufficient to determine the infiltration rate from JM minisystems during "average hydrological conditions". A minimum of two or three measurements was necessary to determine each minisystem's infiltration fluctuation pattern.

The determination of "average" infiltration conditions is subject to error even with accurate plant flow records and supportive night metering data. Since flow records from the Joint Meeting treatment plant were inconsistent; comparison with the infiltration rates at the BCSA plant was used.

"Average Infiltration conditions" for the BCSA service area were developed based on 43 inches of rainfall annually and a monthly precipitation pattern similar to the average pattern presented on Plate 13 of the BCSA SSE Report. These conditions produced an average extraneous flow of 17 mgd of which 16 mgd was average infiltration.

During February-March 1976, the period of Joint Meeting night metering, infiltration rates for the BCSA system were above average, as is typical of these months. Therefore the measured infiltration in the JM system was estimated to be higher than average. Therefore, an adjustment to "average" was necessary.

The sum of the infiltration rates determined by night metering in the 21 minisystems throughout the February-March period of metering was 2.0 mgd. On the nights of metering, the infiltration at the BCSA plant averaged 24.6 mgd compared with an infiltration rate of 16.0 mgd under "average hydrological conditions". The ratio 16.0/24.6 = 0.65, provided the adjustment factor. This ratio was multiplied by the measured infiltration, 2.0 mgd, to determine JM infiltration under "average hydrological conditions", 1.3 mgd. The measured minisystem infiltration rates were likewise multiplied by the 0.65 adjustment factor.

The computed "average" infiltration rate for each JM minisystem is presented in Table 8. The unit infiltration rate, average infiltration per mile, is also listed in this table. Plate 12 schematically presents the unit infiltration rates.

4.3.4 Inflow

4.3.41 Introduction - Direct inflow generally consists of surface drainage which can enter the system through (1) drain inlets, (2) yard drains, (3) roof drains, (4) manhole covers, or (5) storm drain crossconnections. The time pattern of direct inflow is generally similar to the rainfall pattern. This characteristic permitted the quantity of inflow to be computed from the continuous JM plant flow records and the rainfall records. Significant inflow in most sanitary systems occurs during the three percent of the time when precipitation exceeds 0.05 inches per hour. A detailed discussion of inflow and its relationship to precipitation is presented in Section 5.3 of the I/I analysis.

4.3.42 Average Determination - This method was used to determine the average inflow:

1. The daily Joint Meeting Plant Flow was plotted for the 552 days the meter was operating between June 11, 1974 and December 31, 1975.

2. For every day with significant rainfall the increment of flow beyond that anticipated for sanitary base flow and rising infiltration was considered as inflow.

3. This estimated sanitary base flow was subtracted from the total:

a. Weekdays 1.08 x 2.37 = 2.56 mgd
b. Saturdays 0.79 x 2.37 = 1.87 mgd
c. Sundays & Holidays 0.75 x 2.37 = 1.77 mgd

4. The previous days infiltration was also subtracted along with an estimated infiltration increment to account for rain response and a rising base infiltration. The amount of the infiltration increment was evaluated with engineering judgment based on the total increased extraneous flow on the days after the storm.

5. The inflow for the 552 day period was 36.1 mg or a rate of 0.066 mgd. Rainfall during the study period was above average.

6. The inflow for the same period at BCSA was 1.73 mgd compared with a determined long term inflow rate under "average hydrological conditions" of 1.00 mgd.

7. The ratio 1.00 mgd/1.73 mgd = 0.58 was multiplied by the Joint Meeting inflow 0.066 mgd to adjust the test period data to "average hydrological conditions", yielding the average inflow value of 0.04 mgd.

4.3.5 Peaks

4.3.51 Peak Extraneous Flow - Peak extraneous flow can be defined as the peak rate of soil and surface drainage of the tributary area by the system, at a point in the system. Theoretically, its computation involves the estimation of the hydrograph for inflow and infiltration for the mini-systems comprising the portion of the service area which is completely sewered. An analysis of this type is beyond the scope of this report.

4.3.52 Coincident Peak Extraneous Flows - The peak extraneous flow in a typical year is not the sum of peak infiltration and inflow since the probability of these peaks occurring simultaneously is not high. Generally, infiltration peaks are lower during the summer months when the largest rainfalls occur and highest in the late winter when the probability of intense rainfall is low. The determination of the coincident peak infiltration and inflow for Bergen County is discussed in Section 5.6.53 of the BCSA report. Since Joint Meeting will join the BCSA system the peak to average ratios for peak coincident extraneous flows, 3:1 for infiltration and 72:1 for inflow developed for the BCSA system are applicable to the Joint Meeting cost effectiveness analysis. The coincident "design" peak infiltration from the JM area is 1.3 mgd x 3 = 3.9 mgd along with a coincident design inflow of 0.04 mgd x 72 = 2.9 mgd. These coincident peak ratios are rather low because of long time displacement of the actual peak inflow and infiltration contribution of the sub-areas to the annual "design" peak in the BCSA trunk sewers. Higher peak to average ratios apply to system elements further upstream in the system while lower peak to average ratios apply at the BSCA treatment plant.

4.3.6 Benefits of Flow Reduction

4.3.61 The Cost-Effectiveness Analysis General Requirements - The 1972 Amendments to the Water Pollution Control Act and subsequent guidelines from the United States Environmental Protection Agency specified that the cost-effectiveness of the alternate programs of extraneous flow removal be evaluated, and that the program with the highest net economic benefit (benefit of flow reduction minus cost of the physical survey and rehabilitation) be recommended for implementation.

Public Law 92-500 specifies the method to use in evaluating the economic benefit. Costs are assessed on their present worth values over a 20-year planning period using the present 6-1/8 percent per annum, interest rate, to discount future costs and benefits. Beyond the 20-year planning period only a discounted salvage value of improvements is considered. No allowance is made for general inflation, however, if inflation for one item is expected to increase significantly faster than the general rate (e.g., the cost of energy), the difference should be considered. Program evaluation should be based solely on maximizing the total benefit to the Authority and the sum of its participants without regard to municipal boundaries or the source of funding evaluation. Intangible environmental and social benefits from extraneous flow reduction also require evaluation and economic assessment in the analysis.

Degree of Accuracy - The problem with the use of this type of analysis for sewer system evaluation is its implied precision. The method can lead to decisions based on small differences in estimated net benefits. It must always be remembered that the flow components used in these estimates are not highly precise. The method selected for determining extraneous flow probably produced estimates as accurate as could possibly be cost-effectively obtained based on present engineering technology. The economic value, of the social worth of having a sewer which will surcharge with lower frequency or of the environmental benefit due to reducing the frequency of a particular bypass, can hardly be evaluated on any non-subjective basis, even if all the factors affecting such occurrences were accurately quantified. The percent of extraneous flow reduction resulting from various rehabilitation methods was also determined using engineering estimates. With such variables inherent in some elements of the anlysis, fair assumptions based on engineering judgment, can be made in assessing the other elements without sacrificing the degree of accuracy of the total analysis.

4.3.62 <u>Benefits of Average Flow Removal</u> - Benefits from extraneous flow removal derive from the reduction of peak flow and average flows are obtained from both average flow reduction:

1. Possible deferral of further BCSA treatment plant expansion.
2. Reduction of Authority operating costs
    a. At the BCSA treatment plant
    b. At the proposed Joint Meeting Extension Pumping Station
3. Miscellaneous benefits, such as:
    a. Reduction of pipe and street collapes due to foundation washouts
    b. Reduced entry of solids into the system
    c. Higher effluent quality due to lower flows
    d. Reduced ground water pollution caused by exfiltration

The present worth (PW) benefits of the foregoing were estimated using the criteria for interest, inflation, and planning period specified by the federal regulations.

1. <u>Deferral of BCSA Treatment Plant Expansion</u> - Should the flow tributary to the BCSA Treatment Plant increase the rate projected in the BCSA SSE report, about 1.4 mgd per year, the capacity of the 75 mgd plant could be exceeded in about five years and require modular expansion to 100 mgd. Based on a recent estimate, the construction cost of a modular 25 mgd treatment plant expansion would be $14.0 million dollars. This money would be needed about one year prior to expansion completion. The legal and engineering would cost at about $3.5 million dollars and would be needed three years prior to completion. The annual fixed operating and maintenance cost would rise about $0.5 million dollars at the time of completion.

The recommended I/I reduction program for BCSA and JM may reduce anticipated plant flows by about 5.6 mgd. With this flow reduction the plant expansion could be deferred an additional four years. This deferral would produce PW benefits by postponing the costs associated with the project for four years. PW benefits are also derived from a higher plant salvage value at the end of the planning period. Based on these considerations, as detailed in Table 5 the PW benefit of each gpd of average extraneous flow removed is $0.90.

To be conservative, the estimates do not include the cost of expanding future units probably required to meet the more stringent 1983 treatment standards. The expansion of these units could increase the expansion costs present in

Table 5 by about 50 percent.

2. <u>Reduction in operating and Maintenance Costs</u> -

a. <u>BCSA Treatment Plant</u> - Table 6 separates the portions of the 1976 BCSA operating and maintenance (O & M) budget which are fixed and which are flow proportional. This table was developed for the completed 75 mgd expansion assuming an average flow of 60 mgd at present costs. The O & M costs may increase a rate substantially faster than the general inflation rate because of these factors:

1. substantially higher flow dependent operating and maintenance costs associated with the advanced wastewater treatment required by 1983

2. an increase in energy costs far in excess of the general inflation rate.

Accordingly the present annual budget cost was multiplied by adjustment factor of 1.35 to account for this anticipated increase beyond general inflation, averaged throughout the planning period. The present worth of the flow proportional portion of the O & M budget over the 20 years was estimated at $24.0 million dollars or $0.40 per gpd. The PW benefit derived from this category for each average gpd of extraneous flow removed is $0.40.

b. <u>Joint Meeting Pumping Station</u> - Reduced flows at the Joint Meeting pump station will result in lower O & M costs. Based on standard cost curves for the operation and maintenance of sewage pumping stations, it was calculated that PW costs could be reduced $0.10 per gpd extraneous flow removed. The reduction in cost would result mainly from lower energy costs.

3. Miscellaneous Benefits - These are benefits which are derived from reducing average infiltration and inflow for which it is difficult to assign an exact monetary value:

a. Reduced Structural Problems - A substantial percentage of the sewer joints in the system admit infiltration. Infiltration, which seeps through openings in joints and cracks, contains solids from the surrounding backfill and foundation material. The loss of this material can undermine the foundation of the sewer, causing structural failures of not only the sewers but of the nearby parallel utilities or the street itself. Washouts also result in the development of sagged sewer sections. These sags form pockets of septicity which require frequent cleaning.

b. Reduced Solids - Reduction of the solids washed into the system with infiltration and inflow also has an economic benefit. These solids, generally consisting of grit and soil, create excessive wear on pumps and mechanical equipment. The solids often have to be removed from the lower velocity sewers by mechanical cleaning.

c. Higher Treatment Plant Efficiency - The efficiency of most treatment plant units increase as the rate of flow decreases. The reduction of the total flow will, therefore, result in lower quantities of pollutants being discharged into the Hackensack River, regardless of the size of the plant or the design quality standard. Reduction of average infiltration and inflow has an economic benefit for decreasing the amount of pollutants discharged from the plant. Even if the quality standards were being met prior to the reduction, the cleaner effluent produced would continue to provide this benefit.

d. Reduced Exfiltration - Sewers which admit infiltration during high groundwater conditions, generally exfiltrate during low groundwater conditions. This exfiltration of sanitary sewage tends to pollute the ground water. In addition, this reversal of groundwater flow, from infiltration to exfiltration, tends to dislodge soil which had stabilized around the defective point, further disrupting the foundation stability.

For the purpose of this report, the sum of these benefits was nominally assessed at $0.50 per gpd removed. The actual values of these benefits although substantial are subjective with many assumptions based on best engineering judgment. The reasonableness of the estimated $0.50 is apparent when balanced against the conservative estimates used in determining the benefits of deferring treatment plant expansion. For example, if the rate of flow increase in the BCSA service area is half that projected which is entirely reasonable given the slow growth of the area during the 1970's, the increased benefit would increase $0.47 per gpd removed because of the longer period of deferral. A similar increase in this benefit would occur if advanced wastewater treatment units are required which need to be expanded to 100 mgd. The probability of one of these events occuring is high. Therefore any liberality in the assessment of miscellaneous benefits is balanced by the conservatism of the estimate developed for the deferral of plant expansion.

4.3.63 Benefits of Peak Flow Reduction - Benefits derived from reducing peak flows were assessed for the categories; reduction of the Joint Meeting pumping station capacity and miscellaneous. The miscellaneous category includes benefits from:

1. Deferral of capacity increases in municipal lateral and trunk sewers and Authority interceptors,
2. Reduced sewage bypassing, and
3. Reduced sewage flooding of streets, basements and sewerage structures.

Assessing the benefit of peak flow reduction in units of average flow removed is complicated by the highly complex relation between average and peak infiltration and inflow. In the case of inflow, the relation is especially complex. The BCSA I/I analysis developed that for a once--a-year rainfall occurrence, the peak to average inflow ratio is a function of position in the system. The ratio ranges from about 1,000 to 1, directly downstream of a small area inflow source, to about 50 to 1 at the plant. Peak to average infiltration can range from 2 to 1 during a summer-fall design storm or to as high as 5 to 1 during a winter or spring storm. The point of this discussion is that a program of peak flow reduction must include both inflow and infiltration removal. If a program of only inflow reduction is proposed, which can usually be accomplished more economically than infiltration reduction, the magnitude of summer storm peaks decreases, but the amplitude of winter storm peaks of which infiltration is the main component remains virtually unchanged. Therefore, greater benefits derive from a balanced program of removal.

Reduced Pumping Station Capacity - Removal of peak extraneous flow from the system decreases the required capacity of the pumping station. A benefit is obtained mainly from savings incurred by constructing a smaller facility. The benefit of reducing peak extraneous flow was estimated from standard construction cost curve for sewage pumping stations. The curve shows that around 17.5 mgd peak capacity the incremental cost per gpd is about $0.07. Based on a peak to average ratio of 3:1 for infiltration and 72:1 for inflow the benefit is about $0.20 per average gpd of infiltration removed and about $5.00 per average gpd of inflow removed.

Miscellaneous Benefits - As with benefits from average flow reduction, there are several benefits from peak infiltration and peak inflow reduction for which it is difficult to assign an exact monetary value. Based on the peak to average ratios cited previously, the sum of these benefits was nominally assessed at $0.50 per average gpd of infiltration removed and $12.00 per average gpd of inflow removed. These benefits are substantial because they include the value of reduced environmental damage associated with bypasses and sewage flooding. These benefits were considered in deriving the nominal assessments:

1. Municipal Laterals and Trunks and Authority Interceptors - Surcharging may occur due to peak inflow in any of these sewers and paralleling could be required if the upstream extraneous peaks are not reduced. The effect of inflow reduction is especially important in these local sewers. This is because upstream peak to average inflow ratios are significantly higher than the 72:1 used at the treatment plant because of the shorter time of attenuation. The economic benefit of not having to parallel local

sewers is included in the amount assessed for this miscellaneous category.

2. Reduction of Bypassing - The amount of sewage bypassed during extreme storms will be reduced by the program of extraneous flow removal. The increased water quality due to the reduced bypassing has a substantial environmental benefit. Large tangible benefits from this program would be incurred from reducing the peak should storage or treatment of the extreme peaks be required. Additional savings would be incurred by lessening the extent of the cleanup of sewage floatables and solids deposited on the river banks.

3. Reduced Sewage Flooding - During peak inflow and infiltration periods, sewers without emergency overflows surcharge to levels which can flood streets, basements, and sewer system structures. The disadvantages of such flooding are fairly obvious. Street and yard flooding creates an unhealthy condition during the duration of the flooding and requires a substantial cleanup and disinfection effort after each occurrence. In addition to the disadvantage associated with street flooding, sanitary sewage entering basements can destroy valued possessions of the residents along the route of a surcharged sewer. Within the sewer system, sewage solids are deposited on the bench and rungs of each manhole, junction chamber, and meter chamber along the surcharged section. Unless cleaned after each surcharge these solids create noxious conditions in those structures. Reducing the extraneous peak flow derives economic benefit by reducing the occurrence of such surcharging.

4.3.64 Summary of Benefits

Table 4 summarizes the present worth benefit of average and peak extraneous flow removal in units of average gpd removed for each category discussed. This summarizes Table 4.

PRESENT WORTH BENEFIT FOR EACH AVERAGE GPD OF EXTRANEOUS FLOW REMOVED

Infiltration	$ 2.60
Inflow	$18.90

4.3.7 Cost-Effective Infiltration Reduction

In this cost-effectiveness analysis, the cost of further investigation plus the cost of rehabilitation yields the project cost which is balanced against the benefit of removal. Costs and benefits are computed on a present worth (PW) basis, using a 20 year planning period, a 6-1/8 percent discount rate, and no allowance for general inflation. The EPA regulations indicate the method of investigation to be followed when inflow and infiltration are possibly excessive. The method is a Sewer System Evaluation Survey consisting of these steps:

Physical Inspection
Inflow Investigations
Cleaning and Internal Inspection
Final Survey Report

In the infiltration cost-effectiveness analysis the unit costs of the physical inspection, cleaning and internal inspection and the final report have been added to the cost of infiltration removal. The cost of inflow investigations have been included in the inflow cost-effectiveness analysis.

4.3.71 Physical Inspection - The purpose of the physical inspection phase of the SSES is to determine the actual condition of the sewers in minisystems which may contribute excessive infiltration or inflow. Specific details from the inspection are used to:

1. locate sources of infiltration and, to a lesser extent, inflow

2. evaluate the structural integrity of the system

3. make a preliminary determination of the most cost-effective means of rehabilitation

4. eliminate the portions of minisystems probably not contributing excessive infiltration from further evaluation

5. estimate the amount of sewer cleaning required during future survey phases

Field Procedures - Three-man crews under the direction of field supervisors will perform the actual field investigations. A coordinated effort is required between the field and main office where the results will be analyzed.

The field work involves physically entering each manhole and lamping each connected sewer. The light source for lamping is a 200,000 candle power, handle-mounted, iodine-quartz driving light, powered by 12 volt automobile battery. The effective above-ground illumination of these lights is in excess of 2,500 feet. In a typical small diameter sewer, joints can be seen from 25 to 100 feet, depending on the size and condition of the sewer. In large diameter pipes, these lights are visible from manholes farther than 300 feet apart.

Data Collection - At each manhole which the field crew is scheduled to inspect, one or more data sheets will be completed. Inspection results of the manhole and the outlet sewer pipe are compiled on the primary sheet. A separate supplementary page is used to record data for each connected upstream sewer. This system allows the necessary flexibility in compiling data.

Costs - The cost of conducting the physical surveys, analyzing data, and preparing the summary report for the Joint Meeting area was estimated to be $0.49/foot or $2600/ mile of sewer proposed for inspection (1976 prices). The cost includes the labor, equipment, supervision, and engineering needed to perform these tasks:

a) scheduling and coordinating the inspections

b) supervising the inspections

c) entering and inspecting the selected manholes,

d) lamping the sewer reach between consecutive manholes

e) recording inspection data for submittal

f) correlating and evaluating the data

(Cont'd)

g) selecting sewer lengths which should be cleaned and internally inspected

h) preparing a summary report of the results including drafting

i) miscellaneous and unforseen occurences.

4.3.72 Cleaning and Internal Inspection

Purpose - After the physical inspection and inflow investigation, the EPA requires a program of cleaning and televising sewers with possible excessive infiltration/inflow. This program allows the engineer to evaluate internal conditions prior to selecting sewers for rehabilitation and determining the best method of rehabilitation. The length of sewer selected for cleaning and televising will be somewhat less than the length selected for the physical survey, but slightly more than the length finally selected for rehabilitation by grouting. Evaluation of the physical survey data will change the infiltration rating of some sewers from "possibly excessive" to "probably nonexcessive." These sewers will be deleted from the internal inspection program. Similarly evaluation of the televising data may show that certain internally inspected sewers probably cannot be cost-effectively repaired. In these cases, no rehabilitation will be recommended.

Unit Cost - Table 7 presents the unit costs associated with the infiltration reduction program including cleaning and televising costs. The cost includes these items:

1. Cleaning and Threading Winch Cables by Jetting - Cleaning each sewer prior to televising is necessary to avoid smudging the camera lens. Most of the cleaning will

be performed by jetting. Most of the deposited solids are resuspended and washed downstream. Where the depth of the solids is excessive, physical removal from the manhole is required. The jetting device also threads the camera winch cable through the sewer as it cleans the sewer. Floating the winch cable downstream is generally not feasible with the low flows encountered in most sewers.

2. Televising to Assess Defects - The cost for this item includes the cost for in-field assessment of defects and photographs or videotape.

3. Mobilization and Demobilization Between Manholes - This item includes the cost of setting up the winches and pulleys in the manholes and moving the vans.

4. Engineering, Including Supervision, Inspection, and Field Report Preparation - It is intended to contract the actual cleaning and televising operations by competitive bidding. The cost of preparing the specifications, conducting the bidding, supervising the operations, and preparing the field reports which summarize the inspection results is included in this item.

5. Contingencies - This includes miscellaneous and unforeseen occurrences not covered under other items and is estimated at approximately ten percent of the total cost.

6. Total Cost - The total unit cost for cleaning and televising a typical section of sewer is $1.40/foot or $7400/mile. (1976 prices.)

4.3.73 Final Survey Report - Upon completion of the cleaning and televising operations a final report will be issued. This report will include a summary of the prior SSES phases and analyses of the cost-effectiveness of rehabilitation, along with specific recommendations for sewer system rehabilitation. The estimated unit cost of the final report is $1500/mile of sewer recommended for grouting. (1976 prices.)

4.3.74 Suspected Distribution of Infiltration Sources - The minisystems in which high infiltration was measured in the JM and BCSA service areas generally had these characteristics which are relevant to the distribution of infiltration sources:

a) The sewers were constructed 50 to 75 years ago.

b) The street sewers were mainly constructed of 8" clay pipe intermixed with a few larger sized pipes, average diameter 0.7 ft.

c) The street sewers have joints spaced from 2-1/2 to 3 ft.

d) The circumferential joint length per length of street sewer is 0.7 ft. x π/2.7 ft. = 0.81 ft./ft.

e) The street sewer joints were packed with oakum or jute and sealed with cement or tar. These materials are known to lose their watertight seal with age.

f) The length of house connection sewer is about equal to the length of street sewer.

g) The house connection sewers were mainly constructed of 4" diameter clay pipe with some 6" pipe intermixed, average diameter 0.4 ft.

h) The house connection sewers have joints spaced 4 to 5 feet.

i) The circumferential joint length per lenth of house connection is 0.4 ft. x π/4.5 ft. = 0.28 ft./ft.

j) House connection sewers' joints were generally sealed with lead. The water tightness of these joints was generally not checked at the time of construction

k) House connection sewers average a few feet higher in elevation than street sewers

l) During the BCSA physical survey the length of cracks, punctures and breaks observed was minor in comparison with the length of joints observed

m) During the BCSA physical survey the amount of infiltration observed in manholes and from cracks and breaks was minor. Big leaks were seldom observed

n) During the BCSA smoke testing operation, smoke was observed more often seeping through the pavement above the street sewer, than through the ground above the house sewer

o) During the BCSA smoke testing, smoke was seldom observed from the ground around the houses

p) Foundation drains connected to the sanitary system are illegal although some illegal connections are suspected by the local DPW.

Based on the preceeding characteristics these estimates were made:

a) The large majority of infiltration-75%-originates from sewer joints. This is based on age (a); long circumferential lengths (d,i&l); joint material and workmanship (e&j); and lack of infiltration observed from other sources (m&o).

b) Of infiltration originating in sewer joints, four times as much is suspected to originate from street sewers as from house connection. This is based on the ratio of circumferencial joint length per length of sewer (d,F&i); the higher elevation of the house sewer with respect to groundwater (k); and the results of smoke testing (n).

c) Slightly more of the 25% non-joint, infiltration is estimated to originate from cracks, breaks, punctures and manholes, than from foundation and basement drains. This is based on physical survey results (l&m), smoke testing results (o), and DPW interviews (p).

In summary this distribution of sources of infiltration is estimated in the typical sewer section which may be proposed for rehabilitation.

Source	Percent of Infiltration
Leaking joints in Street Sewer	60%
Leaking Joints in House Connection	15%
Cracks, breaks, punctures, and manholes	15%
Basement and Foundation Drainage	10%

This anticipated high percentage from leaking joints in street sewer is specific to the JM and BCSA system because of the age, close spacing and inferior material of sewer joints in minisystems with high metered infiltration. In the more recently constructed asbestos cement sewers, with 13-foot joint spacing, only about 25% of the infiltration is suspected to originate from street sewer joints.

4.3.75 Infiltration Reduction by Grouting - With such a high percent of total infiltration estimated to originate from sewer joints, the most cost-effective method of infiltration reduction is a systematic program of joint grouting. The sewer must be throughly cleaned prior to the grouting operation. A television camera is required to place the grout packer on each joint. Once positioned, the joint is tested for water tightness by low pressure air. Joints failing the air test are immediately grouted before the grout packer is moved to the next joint.

Costs - Table 7-A presents the unit costs associated with grouting program. These items are included:

1. Cleaning and Threading Winch Cables by Jetting - To avoid smudging the camera lens, the sewer should be cleaned before the television camera is inserted. A clean sewer is also necessary for the grouting operation. Most of the cleaning would be performed by jetting. Where the solid deposits are excessive, they are removed from the manhole using buckets. Jetting threads the packer winch cable through the sewer as it cleans the sewer. Floating the winch cable downstream is generally not feasible with the low flows encountered in most small diameter sewers.

2. Mobilization and Demobilization Between Manholes and Pipe Joints - The first part of this item includes the cost of setting up the winches and pulleys in the manholes, moving the vans and cleaning the grout injection tubes. The second part mobilization and demobilization between joints includes the cost for the time between the test and seal of each successive joint, including the time to inflate and deflate the packer's rubber rings, and the time to position the packer on the next joint. The relatively high cost is due to the large number of times the packer is moved where the joint spacing is only 2-1/2 to 3 feet.

3. Air Testing - This item includes the time for conducting the actual air test on each successive joint and recording the results. Again, the relatively high cost per foot is because of the close joint spacing.

If there is a high air test failure rate in certain sewer sections, it may be more economical to grout each joint without air-testing. This equation defines the failure rate above which air-testing is not cost-effective:

$$x = 1 - {}^{b}/_{a} = 62\%$$

in which

x = air test failure rate above which air testing is not cost-effective

a = cost of grouting a non defective joint = \$5.00

b = cost of air testing a joint = \$3.00

Therefore if the actual failure rate in certain sewer sections is signficantly above 62% the field engineer should have the option of asking the contractor to seal every joint in that section without air testing.

4. <u>Grouting Cost</u> - This item includes the cost of grouting each joint which fails the air test. The cost estimate is based on the assessment that about 35 percent of the joints, one joint every eight feet, will require grouting. In actuality, this percentage will vary, and the costs for this item will vary proportionately. However, based on other test-and-seal contracts in the area, an average 35 percent failure rate appears reasonable. It should be noted that the chemical cost is about equal to the labor and equipment cost.

5. <u>Engineering, Including Supervision, Inspection, and Report Preparation</u> - The actual cleaning, televising, air testing, and grouting operations would be contracted by competitive bidding. The cost of preparing the specifications, conducting the bidding, supervising the operations,

and preparing the report on the results is included in this item.

6. Contingencies - This includes miscellaneous and unforseen occurrences not covered under other items. It is estimated at approximately ten percent of the total cost.

7. Total Cost - The total unit cost to grout the defective joints of a typical clay sewer with 2-1/2 to 3 foot joint spacing, and 35% of the joints defective is $5.15/foot or $27,200/mile.

8. Deductions for Joint Spacing Farther Than Typical - The estimated costs do not apply to the more recently constructed sewers. With farther joints spacing, such as 4 to 5 foot spacing in clay pipes and 13 foot spacing in asbestos cement pipe. The cost per length to grout such sewers is estimated about 40 percent less than the typical older sewer because there are relatively fewer joints. The cost benefit-ratio of repairing long pipes was assessed to be the same as for repairing shorter pipes because although the costs would be less the probability of the infiltration originating from joints would be less. Only a small percentage of the sewers in the JM area have joint spacing greater than 3 feet, thus the total average unit cost for sewer repair was not reduced.

Efficiency of Grouting Program - It is estimated that a program of air testing and grouting can remove nearly all of the street-sewer joint infiltration. This amounts to 60 percent of the infiltration in clay sewers with 2-1/2 to 3 foot joint spacing. A lower percentage is removable from sewers with farther joint spacing. To simplify the computation of cost-effectiveness, the amount of infiltration removable from such sewers was estimated as proportional to the cost of rehabilitating the sewer.

4.3.76 Alternate Methods of Infiltration Removal - While this report has concentrated on joint rehabilitation by sealing and grouting, there are other methods of rehabilitation worth discussing. These methods are slip-lining and replacement. Slip-lining involves inserting a flexible plastic liner through an existing sewer, generally from manhole to manhole. Replacement involves excavating, removing and replacing a deteriorated sewer. The reason these methods are mentioned only cursoryily is their high cost. Slip-lining a typical sewer, with a house connection every 30 feet, would cost about $30 per linear foot installed.

The high cost of slip-lining is largely due to the expense of reconnecting the house sewers. On sewers with few house connections slip-lining is more economical.

Sewer replacement costs about $50 per linear foot. An additional $3,000 is also estimated for each pavement opening required to perform this type of rehabilitation. These costs are six and ten times higher than the cost of grouting each joint. With such high costs, these methods only merit inclusion as an alternate in these cases where grouting is not feasible:

1. Specific Sections of large diameter sewer with high visible infiltration.

2. Large, visible, non-joint leaks detected during the televising or physical survey.

3. Large joint leaks which the packer does not successfully repair.

In the final report, each major non-Joint leak not associated with a joint may be quantified and the cost-effectiveness of its repair by slip-lining or replacement evaluated.

4.3.77 <u>Breakpoint for Grouting</u>

<u>Basis</u> - A sewer length is cost effective to grout if the benefit of removal exceeds the cost of removal. Since the unit benefit of removal is estimated to be proportional to the average infiltration rate, and the cost is estimated to be independent of the infiltration rate, grouting is cost effective if:

PW cost of program ($/mile) = PW benefit of removal ($/gpd) x infiltration rate (gpd/mile).

This equation defines the breakpoint in infiltration rate above which grouting is cost-effective:

$$\text{Breakpoint infiltration rate } \left(\frac{\text{gpd}}{\text{mile}}\right) = \frac{\text{PW cost of Program (\$/mile)}}{\text{PW benefit of removal (\$/gpd)}}$$

<u>Present Worth of Cost and Benefits</u> - To simplify the analysis the present worth factor for the costs and benefits was estimated at 1.0. This assumes that the cost and benefits from the program would begin at the start of the planning period; and that the improvements have a twenty year life span, thus no salvage value. In actuality the

SSES phases preceed the benefits. Yet it was decided not to fine tune the analysis by taking this period into account, given the uncertainties of schedulings and approvals.

<u>Program costs</u> - The 1976 costs associated with the program of grouting include:

a) The cost of physical survey x $\frac{\text{length inspected}}{\text{length grouted}}$ =

$2600/mile inspected x 1.5 $\frac{\text{length inspected}}{\text{length inspected}}$ = $3,900/mile grouted

b) The cost of cleaning & TVing x $\frac{\text{length cleaned \& TV'd}}{\text{length grouted}}$ =

$7.400/mile cleaned & TV'd x 1.3 $\frac{\text{length cleaned \& TV'd}}{\text{length grouted}}$ = $9,600/mile grouted

c) The cost of final SSES report = $1,500/mile grouted

d) The cost of grouting = $27,200/mile grouted

Total $42,200/mile grouted

<u>Benefits of program</u> - The benefit of the program equals the benefit of removal of one gpd of average infiltration ($2.60/gpd removed, developed in section 4.3.6) times the ratio of infiltration removable to total infiltration (60 percent, developed in section 4.3.75). The benefit is therefore, $2.60/gpd removed x 0.6 gpd removed/gpd = $1.56/gpd.

<u>Summary</u> - The breakpoint for cost-effective grouting is

$$\frac{\text{\$42,200/mile grouted}}{\text{\$1.56/gpd}} = \underline{\text{27,050 gpd/mile grouted}}$$

4.3.78 <u>Non-uniformity of minisystem infiltration</u> - It was estimated that within each minisystem infiltration is non-uniform. In a typical minisystem, short sections of sewer can be isolated with infiltration rates 2.5 times the average rate for the minisystem. Conversely, sections with less than half the average infiltration rate can be isolated. The basis for this isolation will be:

a) sewer depths and topography
b) soil conditions
c) interviews with DPW personnel
d) physical survey data
e) television data

Based on this estimate, it is effective to grout selected sections of minisystems with average infiltration rates as low as 10,800 gpd/mile (27,050 gpd/2.5). Conversely, it may not be cost-effective to grout certain sections in minisystem with an average infiltration rate as high as 54,000 gpd/mile.

4.3.79 Proposed Program

Physical Survey - There are five minisystems (A,F,G,J and L) with infiltration rates above 54,000 gpd per mile. The 9.34 miles of sewer in these minisystems should be inspected in anticipation of grouting.

There are two minisystems (Q and V) with infiltration rates between 25,000 and 54,000 gpd. The 2.58 miles in these minisystem should be inspected to determine which sections may not be cost effective to grout.

There are five minisystems (B, D, M, P and R) with average infiltration rates between 11,000 gpd and 24,000 gpd.

It is estimated that by physically inspecting 10.15 of the 16.58 miles in these minisystems, the specific sewers which should be televised because of possible excessive infiltration can be better defined. The specific sewers in these minisystems to be physically inspected, were selected based on topographic and soil consideration, DPW interviews and relative infiltration rate.

There are nine minisystems (C, E, H, I, K, N, O, S and T) with infiltration rates 10,000 gpd/mile or less. There are about 17.6 miles of sewer in these minisystems. No physical survey is recommended in these minisystem because the probability of finding a sewer section with rate which would justify grouting is low.

In summation, it is recommended that manholes on 22.34 miles of the JM sewer system should be physically inspected. Table 8 and Plate 15 define the physical survey program. Plate 14 presents the specific sewers recommended for physical inspection. The cost of this program is estimated at \$2,600/mile x 22.34 mile = \$58,000, (1976 prices). When inflated to late 1977 prices the actual cost may be \$65,000.

Other Phases - These are the 1976 costs of other phases based on the length of sewer to be cleaned, televised, and grouted used in the cost effectiveness equation:

a) Cleaning and televising -

$$22.34 \text{ mile inspected} \times \frac{1.3 \text{ mile cleaned \& TV'd}}{1.5 \text{ mile inspected}} \times \$7{,}400/\text{mile clean \& TV'd} = \$143{,}000$$

b) Final report cost -

$$22.34 \text{ mile inspected} \times \frac{1.0 \text{ mile grouted}}{1.5 \text{ mile inspected}} \times \$1{,}500/\text{mile grouted} = \$22{,}000$$

c) Grouting porgram -

$$22.34 \text{ mile inspected} \times \frac{1.0 \text{ mile grouted}}{1.5 \text{ mile inspected}} \times \$27{,}200/\text{mile grouted} = \$405{,}000$$

<u>Net Benefit</u> - Based on:

a) the minisystem infiltration rates,

b) the estimated non uniformity of infiltration within minisystems,

c) A 60 percent removal efficiency,

d) 14.9 miles of sewer grouted,

The recommended program of infiltration removal by grouting may remove 0.641 mgd of joint infiltration for a 1976 PW benefit of $1.66 million dollars. The cost of the SSES and grouting would be $628,000 for a net benefit $1,038,000.

Plate 13 shows the costs, benefits and net benefits for various lengths of sewer grouted. From this curve it appears that the net benefit from grouting 14.9 miles may be about five percent less than grouting only 12.0 miles. However, there are two reasons for selecting a length slightly beyond the optimum for cost effective grouting. First, possible errors inherent in the infiltration allocation indicate a conservative approach and selection of the longer length. Secondly, although the economics of removing infiltration from non-joint sources has not been separately assessed, the infiltration removed may be about ten percent of the infiltration removed from the joints. Since the infiltration cost-effectively removed from non-joint sources will be proportional to the length internally inspected, there is a benefit for selecting a slightly longer than optimum length.

4.3.8 Cost-Effective Inflow Reduction

As discussed in section 4.3.7, the cost of applicable SSES phases is added to the cost of rehabilitation in the cost-effectiveness analysis. These costs are balanced against the benefit of removal times removal efficiency. For the inflow analysis, the only SSES cost considered was the cost of the inflow investigation phase. The costs of the physical survey, cleaning and televising, and final report were assessed to infiltration removal.

4.3.81 Inflow Investigation

Purpose - The purpose of Inflow Investigations, the second phase of the standard SSES, is to identify the sources of inflow tributary to the sewer system. These sources include:

a) catch basins
b) cross connections
c) yard and area drains
d) roof drains
e) soil drains
f) manhole covers subject to flooding

Inflow investigation should be undertaken in areas where inflow source removal is likely to be cost-effective.

Field Procedure - Smoke testing is the recommended method of inflow investigation. Filling each sewer section with a low pressure highly visible non-toxic, non-odorous, non-staining smoke is an efficient procedure for finding most inflow sources. The commercially available smoke bombs utilized, release smoke at a rate of about 300 cfs for a period of five minutes. The smoke bomb is suspended from the underside of a plywood sheet, placed over the manhole opening. After the fuse on the smoke bomb is ignited, an air hose from a portable blower is inserted through an opening in the plywood, to force the smoke through the system. The smoke will rise through any opening not sealed by a plumbing trap and reveal inflow sources. A typical smoke test will indicate most inflow sources within 300 feet of the test manhole.

An additional benefit derived from smoke testing is the detection of infiltration sources. Under normal low groundwater conditions, infiltration sources such as open joints, breaks and defects in the house connection, are detected by smoke rising through the soil over those pipes.

Alerting the residents along the test route is a major task of the smoke testers. Besides placing notices in the local newspapers, a card is hand-delivered to each building along the route a day or two before this test. This card alerts the resident not to be alarmed at the sight of smoke rising from the sewer system or the house plumbing vents. Smoke will not enter the residences unless plumbing fixtures are improperly trapped. Our experience to date in the BCSA survey has shown that smoke will enter less than one percent of the basements along the route because of faulty or improper plumbing connections in those buildings. In such cases, the air blower hose inserted through a basement window can clear the smoke within ten minutes. Proper public relations with the residents affected by the smoke testing is essential.

Report - An interim report for the inflow investigation phase of the SSES will be issued. This report will list all the detected inflow sources by category and by address. The interim report will also indicate what sewers should be cleaned and televised because the infiltration/inflow source detected by smoke was not visible from the manholes. Analysis to show that this cleaning and televising is probably cost-effective may be presented.

The quantity of average inflow from each detected source may be estimated in the interim report. In this report, the term average inflow is used to quantify the inflow from the service area and the individual source. Peak inflow is not used because the effective peak inflow from any source varies from point to point in the system. Peak inflow is a function of the design storm and upstream time of travel. While average inflow in not as common a term as peak inflow, it is more readily estimated, since it is not dependent on system position or design storm.

The quantity of average inflow for a source can be estimated by multiplying the average imperviousness of the catchment by the area of the catchment times the average rainfall (43 in. per yr = 0.12 in. per day = 0.07 gpd per ft^2). As an illustration, a one-acre catchment with 100 percent imperviousness would yield 3,000 gpd of average inflow, or 15 square feet of 100 percent impervious tributary area would yield 1.0 gpd. To make this calculation the area and imperviousness tributary to each source should be estimated. Determination of what percentage of the rainfall will reach the source should also be considered. For example some sources such as slightly raised manhole covers in areas that flood will only admit inflow during flood conditions. Some catch basins and storm drains may be 100 percent tributary to the sanitary system while others are primarily tributary to a storm outlet with minor amounts entering the sanitary system. Flooding the basin or drain with dyed water can aid in differentiating these conditions. Flooding to determine the average inflow quantity is not recommended. Such tests only determine the ultimate capacity of the source and do not determine its contribution under actual storm or average conditions.

The sum of the initially estimated average inflows from all detected sources would then be proportioned to equal 85 percent of total inflow computed from the area. The 85 percent is based on the estimate that smoke testing will disclose 85 percent of the inflow sources. For example, the average inflow from the sum of all sources disclosed by smoke testing would be proportionally adjusted to equal 0.85 x 40,000 gpd = 33,000 gpd.

Cost - The cost of the inflow investigation phase is estimated at $1,600 per mile (1976 prices). This includes all the labor, supervision, and equipment required to perform the field operations and all the engineering drafting, review, and printing required to produce the interim report.

Scheduling - Our experience with the BCSA SSES has shown that the physical survey, normally the first phase of the SSES, provides only marginal data on inflow sources. Based on this experience, the inflow investigations should be conducted simultaneously with the physical survey. The economic advantage of performing these phases jointly is that the field crew does not have to return to the same manholes on two separate dates. Also, questionable manhole connections found during the physical survey can be substantiated as possible inflow sources immediately by the smoke testing phase. A single interim report for the physical survey and inflow investigations would be desireable because all sewers could be evaluated for cleaning and televising.

4.3.82 Final Report - The cost-effectiveness analysis for the rehabilitation of each inflow source would be included in the final SSES report described in section 4.3.73. This analysis will include the estimated PW cost and benefit of removing each source, and the recommended method of removal.

4.3.83 Cost-Effectiveness of Inflow Investigation Data Source - Much of the data used in this cost-effective analysis was developed from the results of the BCSA SSES inflow investigations. Results from 1976 smoke testing of 127.5 miles of sewers in Palisades Park, Ridgefield, Leonia, Englewood and Englewood Cliffs were used as a pilot study. Sewer construction in the pilot area is similar to the sewer construction in the JM area so the reults may be transferred with a degree of confidence.

Pilot Study Data - As determined from continuous authority meters the pilot system had an average inflow rate of 163,000 gpd, or 1,278 gpd per mile. Smoke testing disclosed 370 sources of inflow, 2.90 sources per mile. Based on the estimate that the smoke test detected 85 percent of the inflow sources, the average inflow per source was 375 gpd.

Cost of Removal - The detected inflow sources were grouped into three categories. These categories were based on estimated average costs to rehabilitate sewers where rehabilitation is feasible:

Inflow Source	Pilot Study Sources Detected	Typical Cost to Remove (where removal is feasible)
Cross-connection and catch basin	163	$7,500
Area and yard drains	76	$1,000
Roof drains and manholes subject to flooding	131	$ 300

Based on this distribution the average cost to remove a typical inflow source is:

[(163 x $7500) + (76 x $1000) + (131 x $300)]/370 sources = $3615/source. Based on 375 gpd per source, this is $9.64 per gpd.

<u>Benefit of Removal</u> - The PW benefit of removing a typical source is $7,087, based on 375 gpd per source and $18.90 per average gpd of inflow removed (developed in section 4.36).

<u>Cost Effectiveness</u> - Based on the developed PW costs and benefits the removal of a typical source yields a net benefit of ($7,087-$3,615) = $3,472 and a benefit-cost ratio of 1.96. The only way that a program of inflow removal would not be cost-effective is if the cost of locating the typical source was over $3,472. Plate 16 illustrates this concept. Based on inflow investigation costs of $1,600 per

mile, this would occur if there was less than 0.46 removable sources per mile. In the pilot study area there were 2.9 detected sources per mile. Based on the estimate that about 83% of these sources could be cost-effectively removed, there would be 2.4 removable sources per mile. Estimating that the sources per mile are proportional to the inflow per mile, the sources per mile in the JM system is $\frac{870gpd}{1290gpd}$ x 2.4 removable sources per mile = 1.6 removable sources per mile.

As 1.6 removable source per mile is 350 percent higher than the cost effective breakpoint (0.46 removable sources per mile) the program of smoke testing the entire JM area is highly cost-effective.

Further Inflow Measurement - Further inflow metering prior to smoke testing, would be cost-effective if substantial portions of the system could be eliminated from the smoke testing program by such metering. Since the entire system has an inflow rate 3.5 times the cost-effective breakpoint there is little probability of isolating such an area. Because the cost of meaningful inflow metering is relatively high while the cost of smoke testing is relatively low, no further inflow metering is recommended.

The approach of no additional inflow metering has been accepted by the EPA for the BCSA SSES. Entire systems as long as 50 miles (Teaneck Meter Area 12) have been approved for smoke testing without further subdivision and metering.

4.3.84 Proposed Program - It is proposed that the entire 46.0 mile system should be smoke tested to detect inflow sources. The inflow investigation program as defined in section 4.3.81, which should be performed concurrently with the physical survey, may cost $74,000. The subsequent rehabilitation program may cost $270,000 providing a benefit of $529,000 by removing 28,000 average gpd of inflow. Table 9 summarizes the costs and benefits of the program. It should be noted that the net benefit of $4,000 per mile places this program well within the range of the Priority II smoke testing program for BCSA, which is presently underway.

4.3.9 Conclusions and Recommendations

4.3.91 Conclusions - This report demonstrates that it may be cost-effective to detect and remove the excessive infiltration and inflow from the JM system. The proposed inflow reduction program may cost $344,000, ($74,000 for SSES, $270,000 for rehabilitation), and reduce inflow 70% (0.028 mgd average) for a present worth benefit of $529,000. This is a net benefit from inflow reduction of $185,000.

The physical inspection survey may cost approximately $58,000 and provide a basis for determining the most cost-effective infiltration reduction program. Future cleaning and televising may cost $143,000 and the final survey report may cost $22,000. An estimated total cost of $628,000 ($223,000 for SSES and $405,000 for joint grouting) may reduce infiltration 49% (0.64 mgd) for a present worth benefit of $1,666,000 and a net benefit of $1,038,000. Additional unassesed benefits may derive from repairing non-joint infiltration sources detected during televising.

4.3.92 Authorizations Recommended - Based on the results of this report it is recommended that the Environmental

Protection Agency authorize the following programs:

1. The physical inspection of 22.34 miles of the sanitary sewer system within the twelve mini-system, specified in Table 8.

2. Simultaneous inflow investigation by smoke testing of the entire 46 mile sanitary sewer system. These inflow investigations are within the cost-effective range of the Priority II Inflow Investigation Program for the Bergen County Sewer Authority which the EPA has previously authorized.

4.3.93 Scheduling - It is anticipated that the field work involved with these two SSES phases may be completed about 5 months after EPA authorization to proceed. Upon completion, interim SSES report detailing the results of the physical survey and inflow investigations will be prepared. This report will also recommend specific sewer lengths for the cleaning and televising phase of the SSES.

4.4 Performance of Existing Systems

4.4.1 BCSA Treatment plant - The Bergen County Sewer Authority plant provides secondary treatment for sewage from 500,000 residents in 43 contracting municipalities. Average flows are about 65 mgd. The Authority is presently expanding the plant's capacity from 50 to 75 mgd average flow. The first stage of this expansion is scheduled for completion in 1977, the second stage is scheduled for completion in 1981.

The NJDEP has classified the segment of the Hackensack

River into which the BCSA sewage treatment plant discharges as "Water Quality Limited" TW-2. In accordance with this classification, the current NPDES permit for the BCSA plant during construction, requires a minimum of 75 percent removal of the influent BOD, and suspended solids over a 30 day period. The permit also specifies a maximum effluent BOD and suspended solids level of no more than 75 ppm over a seven day period and no more than 50 ppm over a 30 day period. These limits will be tightened when the expansion is completed.

Because the Hackensack River is designated "Water Quality Limited" the BCSA plant may soon need to provide better than secondary treatment. In Special Grant Conditions established by the EPA for the current plant, expansion commits the Authority to prepare a facility plan detailing alternate methods of obtaining the specified water quality.

The present ocean dumping permit for the plant requires complete digestion of all primary and secondary sludge barged to the Atlantic dumping area. In addition, the permit directs the Authority to prepare a facility plan recommending the most cost-effective method of sludge disposal in anticipation of a ban on ocean dumping.

4.4.2 Joint Meeting Treatment Plant

Since its construction in 1940, the plant has performed inadequately. The inadequate treatment results mainly from operating and maintenance problems. Treatment units which malfunctioned were removed and not repaired. The mechanical equipment has become obsolete. Presently, the trickling filters often clog requiring the flow to be bypassed, improperly pretreated industrial wastes entering the filters has inhibited biological growth on the filter stones. The sludge withdrawal system in the settling tank no longer functions and the tanks must be bypassed and dewatered to remove the sludge. The two-phase sludge digester serves mainly as a holding and dewatering tank.

The sludge incineration facilities are inoperable and thickened sludge is pumped to a nearby lagoon. Operation of the coagulating tank equipment has been discontinued. A few years after construction, the magnetite filters clogged and this unit has been bypassed since that time. Additionally, sections of the plant administration building have developed structural cracks caused by support pile deterioration.

The JM plant now provides less than primary treatment, removing on the average only about 25 percent of the BOD and suspended solids from the influent sewage. Such treatment is not acceptable for discharges to Berry's Creek. Tests in 1972 revealed the waters of Berry's Creek to be anaerobic.

The Joint Meeting is presently under EPA and State orders to discontinue operation of the JM plant and to connect to the BCSA system. The three municipalities, Carlstadt, East Rutherford and Rutherford, have indicated they will comply with this directive. The Joint Meeting will determine the ultimate disposition of the abandoned plant facilities.

5.0 FUTURE SITUATION

5.1 Land Use

The 1975 Bergen County composite zoning map indicates areas which are presently developed in the Joint Meeting service area. Table 1, which summarizes the present land use shows that most of the area is developed although several large tracts remain vacant. These tracts will probably be developed and sewered by 2020, the end of the design period.

Carlstadt - A fully developed 64 acre industrial tract along Carlstadt's western boundary is presently unsewered. A construction program for sewering this area tributary to JME is now being implemented. These sewers should be operational by the end of 1977. An additional undeveloped 20 acre plot zoned one and two family residential, and undeveloped 70 acre plot east of Route 17, zoned light industry and office, will probably be developed by 2020. Thirty undeveloped acres in the Carlstadt Meadowlands are zoned for an open space preserve by the Hackensack Meadowlands Development Commission (HMDC).

East Rutherford - In East Rutherford, 20 acres, zoned light industry and office, remain to be developed.

Rutherford - The undeveloped Meadowlands portion of Rutherford, about 400 acres, extending from the Route 3 and

17 Interchange to the Hackensack River is under the jurisdiction of the HMDC. A ten acre area at this interchange is zoned for highway commercial development. Berry's Creek Center, planned as the focal point of the Meadowlands District, will occupy about 100 acres in Rutherford and contain shopping, civic, cultural and transportation facilities. The remaining 290 acres is scheduled for high rise apartments constructed to follow HMDC guidelines. An alternate plan to construct a convention center on the site zoned for high rise apartments is now under consideration.

5.2 Demographic Projections

The 1973 project report on the Joint Meeting Extension presents the projected populations for the service area. These projections were based on the entire residential population tributary to the Joint Meeting plant remaining west of Route 17. These projections, from that report, were based on land use plans developed by the three boroughs and HMDC at that time:

Year	Population			
	Carlstadt*	East Rutherford*	Rutherford*	Joint Meeting
1976	6,800	5,800	9,900	22,500
1980	9,300	6,500	12,700	28,500
1990	11,900	7,900	14,700	34,500
2000	14,400	9,400	16,800	40,600
2010	16,500	10,500	18,400	45,400
2020	17,300	11,000	19,000	47,300

*Joint Meeting portion only

The population projections reflect that substantial high density development may occur near the new sports complex and proposed convention center. It is anticipated that much of the older single family dwelling stock may be replaced by multi-family housing units during the design period.

5.3 Forecasts of Flow

5.3.1 Domestic Flow - The population projections presented in Section 5.2 were used to estimate average future domestic flow in each municipality. Based on a domestic flow contribution of 100 gpd per capita, which includes an allowance for commercial and institutional flow and non-excessive I/I, these domestic flows were projected:

Domestic Flow (mgd)

Year	Carlstadt	E. Rutherford	Rutherford	Joint Meeting
1976	0.68	0.58	0.99	2.25
1980	0.93	0.65	1.27	2.85
1990	1.19	0.79	1.47	3.45
2000	1.44	0.94	1.68	4.05
2010	1.65	1.05	1.84	4.54
2020	1.73	1.10	1.90	4.73

5.3.2 Industrial Flow - The industrial flow projections were determined based on an average 2010 discharge of 2500 gpd/acre from land industrially zoned in 1971. Since that time certain planning changes have occurred. As reflected in Table 1, some of the industrial area in Carlstadt has been zoned for open space; the total industrial land in East

Rutherford has increased; and much of the industrial land in Rutherford is now planned for regional centers. The net effect of these changes on future projected flows was assessed and found to be minor. Therefore, the projecture from the earlier project reports have been used in this Facility Plan. The average flow from lands zoned industrial in 1971 were projected to increase uniformly from present (1976) levels until 2010 when industrial growth was estimated to be complete. These are the flows:

		Industrial Flow (mgd)		
Year	Carlstadt	E. Rutherford	Rutherford	Joint Meeting
1976	0.40	0.34	0.03	0.79
1980	0.43	0.35	0.20	0.98
1990	0.53	0.37	0.63	1.53
2000	0.63	0.39	1.06	2.08
2010	0.73	0.41	1.49	2.63
2020	0.73	0.41	1.49	2.63

5.3.3 Peak Flow - Future peak flows were estimated from the average flows using the standard peak to average ratios used to design all BCSA facilities, presented in Table 10. The preliminary design of the pumping station, influent sewers and force main were based on these ratios.

5.3.4 Flow Summary - This table summarizes the projected average and peak flows combining the domestic and industrial flows from the Joint Meeting service area based on the criteria developed in sections 5.3.1-3:

Year	Average Flow (mgd)*	Peak Flow (mgd)
1976	3.04	8.4
1980	3.83	10.0
1990	4.98	12.5
2000	6.13	15.0
2010	7.17	17.0
2020	7.36	17.5

*Excluding excessive infiltration

5.3.5 Non-Excessive Infiltration and Inflow - From the infiltration inflow analysis it was determined that the average infiltration rate was 1.30 mgd and the average inflow rate was 0.04 mgd. The preliminary cost-effectiveness analysis indicated 0.66 mgd of infiltration may be cost-effectively removed by a rehabilitation program. Cost-effective removal of inflow sources discovered during the physical inspection and smoke testing operations may remove 70 percent of the 0.040 mgd average inflow, or 0.028 mgd. Therefore average non-excessive infiltration may be 0.64 mgd, and non-excessive inflow maybe 0.012 mgd.

5.3.6 Flow Characteristics - Joint Meeting sewage contains a considerable amount of industrial discharge. Periodically, batches of industrial wastes received at the JM plant, have overloaded the plant units and upset the biological action within the trickling filters. The shock load effects from these wastes have reduced JM plant efficiency.

5.3.7 Sewage Overflows - The system tributary to the proposed JME is comprised entirely of separate sanitary sewers. There are no combined sewers. However, a storm-sanitary system interconnection was discovered during our preliminary field investigations, indicating the possibility of other such connections. The proposed inflow investigation should effectively detect any other cross-connections.

5.3.8 Possible Flow Reduction

5.3.81 Reduction of Industrial Flow - Flow from the service area will eventually be treated at the BCSA plant. Therefore, pretreatment requirements of the Authority will apply to the Joint Meeting industries. Industrial discharges may be sampled on a regular basis at the point of entry. If the wastes entering the system fail to meet discharge standards then pretreatment will be required. Discharge of uncontaminated cooling water to the system is also prohibited.

Carlstadt, East Rutherford and Rutherford intend to implement an industrial waste regulation and an equitable cost recovery regulation which will meet EPA requirements. This program will be developed and coordinated in conjunction with the BCSA program.

As discussed in section 4.2.42, most of the industries in the service area discharge small quantities of sewage.

instructing the JM to join the the BCSA would have to be reversed. Such implementation difficulties would certainly delay the abandonment of the JM plant.

An evaluation of environmental issues also weighs against the PVSC transfer. Primary adverse impacts caused by construction of the needed connecting sewers, although temporary would be greater because the construction would occur through a more densely developed area. Adding the JM flow to the PVSC trunk would raise the hydraulic profile in that sewer. Since the trunk intercepts combined sewer systems the quantity of combined sewage bypassed to the Passaic River would increase because of the lost trunk capacity used to convey JM flow. The interbasin transfer of JM flow would cause another adverse impact. Effluent from the BCSA Plant discharges to the tidal Hackensack River twelve miles above the outlet. The effluent of the PVSC Plant discharges to Upper New York Bay. Removal of the JM effluent would decrease the flow in the lower Hackensack River. This would result in slightly longer detention time of pollutants, more saltwater intrusion and slightly lower average river water levels available to recharge aquifers.

6.3 Upgrading the JM Plant

6.3.1 Background - The 1966 JM Preliminary Report on Sewerage Facilities considered five alternate schemes for sewering the JM area and the eastern portions of Carlstadt and East Rutherford. The schemes included combinations of

Therefore, the imposition of user charges and industrial cost recovery of pretreatment costs may have a limited effect on reducting the anticipated industrial flows.

5.3.82 Changes in Comsumption Patterns and Possible Conservation Methods - Nearly all of the base domestic sewage originates from toilets, sinks, baths, washing machines and dishwashers. Changes in people's habits in the usage of these facilities may change both peak and average flows. The per-capita quantity of base domestic flow has risen several fold over the past 200 years, as an inexpensive abundant source of water became available, and as water consumptive facilities became standard in every house.

Nationally, the number of persons per dwelling unit has decreased from 3.67 in 1940 to 2.92 in 1975. A similar trend has occurred in the NJ area. The Federal census bureau has projected that the number of persons per dwelling unit may decrease about one percent per year until 1990. This may tend to increase the per capita consumption.

The trend of small households using more water per capita is logical. Large families can have their clothes washed, meals prepared and dishes washed with full loading of the applicances. For example, it takes about as much water to wash the dinner dishes of a household of two as a household of six. Also, the time available for excess per capita use of water is greater in the small households.

The single person can luxuriate in the shower for longer periods each day without the constraint of other people wanting to use the facility during the same time period. Small families are also more likely to reside in apartments. Apartment residents are not generally billed directly for their water use, so an economic incentive for the tenant to repair leaking fixtures or conserve water is lacking.

Wealthier areas show higher per capita flows since residents can afford water consumptive dishwashers and multi-bathroom houses. Affluent households have little economic incentive to conserve water. A higher level of affluence in the service area could lead to high per capita flow rates. Water conservation methods, such as low flow shower heads or placing bricks in the toilet tanks, to decrease the flush from five to three gallons could lower sewage flows. Certain municipalities have passed laws requiring the use of such devices. The benefits of lower water usage by such legislation must be carefully weighed against (1) the cost of enforcement, (2) the cost and inconvenience to the residents having to convert their usage, and (3) the political cost of resentment toward government attempts to regulate individual personal habits.

A more effective means of conservation would be the billing of each individual consumer for sewage service on the basis of the water billing, rather than on an ad valorem basis. This could create a stronger economic incentive to the homeowner to repair leaking fixtures, which may comprise as much as 20 percent of the base sewage, and to conserve water without legal compulsion. However, one disadvantage is that such billing would grant an artificially high benefit to those who conserve water, because the majority of sewage costs are fixed and not flow dependent. Also, under present billing procedure, the homeowners may deduct ad valorem property taxes which include sewerage costs from their federal taxes. Direct billing would not be deductible under present legislation. It would be a political liability for the JM or the Authority to voluntarily change to a direct billing system, unless the laws were revised.

5.3.9 Limitation Upon Future Flows - Future flow increases will be limited by the availability of vacant land which is suitable for more intensive development. Most of the undeveloped land lies within the meadowlands area. HMDC zoning indicates high rise apartment complexes, natural preserves, and a public center which includes a shopping center, convention hall, and recreational facilities may be constructed. West of Route 17 the rate of flow increase will be limited by the rate at which the older homes are sold to make way for the more intensive development anticipated.

Several open tracts of land are zoned for industrial development. Industrial flow increases will be limited by the availability of land as industrial sites.

5.4 <u>Future Environment of the Planning Area Without the Project</u>

The no action alternative to the project would require that the Joint Meeting treatment plant continue to operate in defiance of the State and Federal orders.

Berry's Creek would continue to receive increasing amount of insufficiently treated wastewater discharges from the JM treatment plant. When the JM plant capacity is exceeded, the increased pollution would further degrade the quality of Berry's Creek.

The area immediately surrounding the plant site would continue to be damaged from the sludge lagooning. Increased flows to the plant would increase the land area utilized by the sludge lagoons.

6.0 Alternatives to Proposed Project

Scope

These several alternatives to the proposed project were considered.

1. no action
2. diverting JM flow to the PVSC system
3. upgrading the existing JM Plant
4. constructing a separate pump station for Carlstadt
5. discharging to the BCSA through the East Rutherford Municipal system.
6. modifying the service area by including Lyndhurst-North Arlington, or rerouting minisystem E and F
7. discharging to the BCSA by gravity
8. utilizing the JM administration building for the proposed pumping station
9. routing the proposed force main north of Paterson Plank Road

This section briefly discusses what each alternative would entail and the reasons why each was not selected.

The first three alternatives are no longer seriously being considered because of the State order for the JM to cease operation and connect to the BCSA system. Alternative 3 was previously evaluated in the 1966 JM Preliminary

Report on Sewerage Facilities. Alternatives 4 and 5 were previously evaluated in the BCSA 1971 Project Report. The alternates involving pipe routings are shown on Plate 21.

6.1 No Action

The alternative of no action would involve continuing the present pollution of Berry's Creek by allowing the malfunctioning JM Plant to remain in operation. Such a strategy is clearly unacceptable because of the poor quality effluent discharged by the plant. In addition the area immediately surrounding the plant site would continue to be damaged from the sludge lagooning. The court order to cease JM plant operation prevents this alternative from being seriously considered. However, a "Max-Min" study is now being prepared to determine the most inexpensive-effective method to upgrade the plant operation until the proposed JME project is operational.

6.2 Diverting JM Flow to PVSC

The alternatives of pumping the JM flow westward over the drainage divide to the Passaic Valley Sewer Commissioners system was considered. Two interceptors in the PVSC system, the Rutherford-Lyndhurst Branch Interceptor and the Rutherford-East Rutherford Branch Interceptor serve the western portions of Rutherford and East Rutherford. Either interceptor could serve as a point of connection to the PVSC System for the JM flows.

Alternative 2A, conveying the Joint Meeting flow to the PVSC trunk sewer through the Rutherford-East Rutherford Branch Interceptor, would involve:

1. Construction of a 17.5 mgd pumping station and 8000 foot force main along the Rutherford-East Rutherford boundary to convey the flow over the 60 foot ridge.

2. Construction of a gravity sewer along the boundary about 3000 feet long and 36 inches in diameter.

3. Paralleling the PVSC Rutherford-East Rutherford Branch Interceptor.

4. Future modification of the PVSC Wallington Pumping Station to convey the peak flow from the JM area.

Alternative 2B, conveying JM flow to the PVSC system through the Rutherford-Lyndhurst Branch Interceptor is also possible. This alternate connection would involve:

1. Construction of a 17.5 mgd pumping station and a 5,000 foot force main to convey the flow over the 110 foot ridge in central Rutherford.

2. Construction of a gravity interceptor about 2,000 feet long and 36 inches in diameter.

3. Paralleling the PVSC Rutherford-Lyndhurst Brann Interceptor.

4. Future modification of the PVSC Yantacaw Pumping Station to convey the peak flow from the JM area.

The transfer of JM area flow to the PVSC system, rather than to the BCSA system, was not selected for economic, jurisdictional, and environmental reasons. The cost of the sewers to convey the flow to PVSC would be substantially higher. The power costs would also be significantly higher because of the higher static head to cross the ridge and additional energy cost to pump across the Passaic River. Plant costs, both operating and expansion, would be slightly lower at PVSC because of the economy of scale at the giant PVSC Plant.

Implementation of a transfer to PVSC would present difficulties. The BCSA has been the regional planning agent for the JM area, because the area is within the Bergen County-Hackensack River Sanitary Sewer District. In its long range planning BCSA has always considered providing treatment to the JM area. On the other hand, no consideration was given by the PVSC to conveying or treating JM area flow. A new set of legal and contractual agreements between the JM, PVSC, BCSA and the three boroughs would need to be implemented. In addition the present Court Order treating portions of this flow (1) at the BCSA plant (2) at an upgraded JM Plant (3) at a new plant on the Hackensack River. During the late 1960's and early 1970's the eastern portions of Carlstadt and East Rutherford were sewered with the discharges pumped to the BCSA Hasbrouck Heights Trunk Sewer. Thus, several alternates presented in the 1966 report including the Hackensack River Plant, are no longer valid.

However the analysis of the two basic alternates for serving the JM area, (1) at the BCSA Plant (2) at an upgraded JM Plant, remains valid. The report recommended, the Joint Meeting should not upgrade the JM Plant unless large federal grants were available for the purpose of upgrading. Otherwise the JM area should be sewered to the BCSA plant. This conclusion was based mainly on economic considerations. The report demonstrated that upgrading would be the more expensive alternative. Based on this and subsequent analyses, the court ordered the JM to connect to the BCSA system.

These issues were evaluated in recommending the alternative of transfer to the BCSA over upgrading the existing plant:

1. Berry's Creek-Hackensack River water quality
2. Reliability
3. Sludge Disposal
4. Construction Impacts
5. Construction Costs
6. Operating and Maintenance Cost
7. Implementation

6.3.2 Berry's Creek - Hackensack River Water Quality - As mentioned in Section 4.1.4 the water quality in Berry's Creek is presently so poor that at times of the year the stream is anaerobic. The streams poor quality is mainly due to the poor operation of the JM plant. Upgrading the JM plant would reduce the unsatisfactorily high BOD and SS load discharged to Berry's Creek, and raise the dissolved oxygen level. However the effluent from an upgraded JM plant would result in higher concentration of BOD, SS, phosphorous organic nitrogen and heavy metals, (and lower dissolved oxygen) in Berry's Creek than would result if the effluent were eliminated. When the JM effluent is removed, the only treated sewage discharged to Berry's Creek will be from the 0.7 mgd Wood-Ridge municipal plant.

The benefit of upgraded Berry's Creek quality will be somewhat balanced by the slight lowering of the Hackensack River quality between the BCSA plant outfall and Berry's Creek. The lowering of the Hackensack River quality will be much less than the increase of Berry's Creek quality because of the much larger base flow in the Hackensack River and the better quality effluent produced by the BCSA plant.

The beneficial effect of higher Berry's Creek quality will be somewhat offset by the disadvantage of lower flows. Average Berry's Creek flow would be reduced about 30 percent. This lower flow will result in longer pollutant resident time, slightly increased salt water intrusion and slightly lower creek levels available to recharge aquifiers. These disadvantages will be somewhat offset by the beneficial effect of higher flow rates in the section of the Hackensack River between the BCSA Plant and Berry's Creek.

6.3.3 Reliability - Many JM industries discharge process wastes. In the past these wastes have caused plant operating difficulties. The smaller the treatment plant the more vulnerable the biological processes are to upset by industrial shock load. The BCSA plant currently treats large quantities of industrial wastes, and the plant processes were designed to accomodate these wastes. Therefore the reliability of treatment would be greater at the larger BCSA plant than at a smaller upgraded JM plant. To achieve the same degree of reliability at the JM plant a more stringent monitoring of industrial discharge would be necessary.

6.3.4 Sludge Disposal - The JM plant was constructed with digestion, vacuum filtration, and incineration units for sludge disposal. Currently the raw sludge is lagooned because all sludge disposal facilities are in disrepair. If the JM plant were upgraded, the sludge disposal facilities would have to be repaired and upgraded, or another means of disposal implemented. Regional sludge disposal at the BCSA plant appears to be a more economically and environmentally sound alternative. The quantity of sludge originating from the Joint Meeting sewage is small in comparison with the amounts currently processed at the BCSA plant.

Treatment at the large BCSA plant would be the more economical method of sludge disposal because of economy of scale. The advantages of using large regional facilities for sludge disposal are presented in a report by Camp, Dresser & McKee for Interstate Sanitation Commission entitled "Technical Investigation of Alternatives for the New York-New Jersey Metropolitan Area, Sewage Sludge Disposal."

The BCSA is currently investigating alternate means of sludge disposal to replace ocean dumping. These facilities will be designed to provide the most environmentally sound, cost-effective means of disposal, and will be designed to process the additional sludge originating in the JM sewage without further expansion.

6.3.5 Construction Impacts - The major primary environmental impacts involved in implementing either alternative would be caused by construction. These impacts would, for the most part, be temporary.

Upgrading the JM plant would be a less environmentally disturbing alternative than transferring flow to BCSA, in terms of construction work. All facilities would be constructed on the existing plant site, and no sewer construction, outside the plant site, would be required.

This would eliminate the possibility of disturbance to the Meadowlands. Conversely the major adverse impact of the proposed project will be caused by construction of the force main. Most of the force main will be constructed in East Rutherford in the shoulder of Murray Hill Parkway and the shoulder of Paterson Plank Road. The property abutting these roads is zoned industrial west of Berry's Creek and is part of the Sports Complex east of Berry's Creek. With properly supervised construction, the adverse impacts caused by constructing the force main should be temporary and minimal.

The construction of the force main across Berry's Creek, needed to transfer flow to the BCSA system, would create another adverse impact. Some temporary disturbances to the ecosystem will occur, however, conditions would return to normal after completion of the project.

The long range commitment of energy and material required for both alternatives was also evaluated. The commitment of both energy and material involved with JM plant upgrading is greater than with the proposed BCSA JME project.

6.3.6 <u>Construction Costs</u> - The construction cost for both alternates was evaluated and the cost to upgrade the JM plant was found to be higher. This is true even when the PW value of deferring the BCSA plant expansion from 75 to 100 mgd. associated with the upgrading alternative is considered.

6.3.7 Operating and Maintenance Cost - The PW O & M costs involved with treating the JM flow at the upgraded JM plant were compared with the O & M costs for the proposed JME pumping station and for the increased flow at the BCSA plant. The operating and maintenance of operating an upgraded JM plant was higher.

6.3.8 Implementation - Planning the transfer of JM flow to the BCSA plant began over ten years ago, after the 1966 report. Much planning has been expended toward this goal including all necessary legal contracts between the Authority and the municipalities. A court order has been issued to implement the transfer. A decision not to tranfer the flow would delay several years the reduction of existing JM plant generated pollution.

6.3.9 Summary and Conclusion - These considerations favored the alternative of upgrading the JM plant.

1. The adverse impact of lower velocities in Berry's Creek is greater than the beneficial impact of higher velocities in the Hackensack River.

2. There would be less disruption of the local ecosystems along the proposed force main route.

3. There would be less dust and noise affecting the public during construction.

4. There would be less traffic delays and inconvenience to industries along the force main route.

These considerations favored the alternative of constructing the JME pumping station and forcemain:

1. The benefit from increased Berry's Creek water quality from eliminating the JM effluent will be greater than the adverse effect of lower Hackensack River water quality from added BCSA effluent.

2. The BCSA plant is less susceptible to upset from industrial shock loads and is therefore more reliable.

3. Sludge processing facilities at BCSA are more adequate.

4. There will be less long term expenditures of energy and materials involved with the BCSA alternative.

5. The construction costs involved with the BCSA alternative are lower.

6. The operating and maintenance costs involved with the BCSA alternative are lower.

7. The steps already taken to implement the BCSA transfer will allow its completion several years before upgrading the JM plant could be completed.

Upon evaluation, the latter considerations outweighed the former, reaffiriming the correctness of the decision to transfer JM flow to BCSA.

6.4 A Separate Carlstadt Pump Station - In 1971 it was not certain that the three JM municipalities could agree on a common scheme to convey their sewage to the BCSA system. The BCSA 1971 Project Report analyzed Alternate B and C in which flow from Carlstadt would be pumped from a new station on Route 17 at Broad Street. The force main, shown as alternative 4 on Plate 21, would extend eastward along Broad Street, across Berry's Creek and through the Meadowlands, discharging to the BCSA East Rutherford Extension (ERE) force main at Jony Drive and Commercial Avenue. With alternate B, a force main conveying the rest of the JM flow would connect to the Carlstadt force main at Broad Street near Berry's Creek.

The total cost of transferring JM flow to BCSA would be more expensive with separate pumping station for Carlstadt, (Alternates B & C) than with the proposed JME extension project, (Alternate A). Alternates B and C would be less costly to the BCSA had Carlstadt constructed, operated and maintained the separate Carlstadt pumping station.

The adverse environmental impacts associated with the separate Carlstadt station would be more severe than those associated with Alternate A. There would be a longer length of force main construction required, and the force main would cross an environmentally sensitive section of marshland preserve east of Berry's Creek. Because of the higher adverse environmental impact and the higher total project cost, a separate Carlstadt JM pumping station was not recommended.

6.5 <u>Utilizing the East Rutherford Municipal Sewer System</u> - In the 1971 BCSA Project Report, the alternative of using the existing East Rutherford sewer system was analyzed as an element of Alternate C. Instead of extending a force main from the JM plant site to the BCSA ERE force main, Alternate C planned for the force main to extend only to the existing 36" municipal sanitary trunk sewer in Murray Hill Parkway near East Union Avenue. From that point the JM sewage would flow by gravity through the municipal trunk to the East Rutherford Municipal Pumping Station. There, the sewage would be re-pumped to the BCSA ERE force main. Alternative 5 on Plate 21 shows this plan.

The advantage of this plan would be that about 1.3 miles less force main would have to be constructed in East Rutherford. This would produce less construction related adverse environmental impacts; and the cost of the JME pumping station and force main would be reduced. The main disadvantage of this scheme is that the East Rutherford trunk sewer does not have sufficient excess capacity to convey all the JM flow. The alternate would only be feasible if the separate Carlstadt JM station were constructed. In addition, the East Rutherford Municipal Pumping station would require enlargement if the Rutherford and East Rutherford JM flows were diverted through the municipal system. The extra costs and adverse impacts associated with a separate Carlstadt and enlarged East Rutherford Pumping Station were evaluated to outweigh the advantages of the shorter JME force main.

6.6 Service Area Modifications

6.6.1 Lyndhurst-North Arlington Extension - The possibility of Lyndhurst and North Arlington abandoning their joint plant (two miles south of the JM plant) and connecting to the BCSA system through the JME was also considered. The Lyndhurst-North Arlington (LYN-NA) plant serves the eastern slopes of these two municipalities, which are within the Bergen County-Hackensack River Sanitary Sewer District. The alternative would involve constructing a pumping station at the LYN-NA plant site and a force main extending to the proposed JME pumping station, shown as Alternative 6A on Plate 21.

However, Lyndhurst and North Arlington have expressed no desire to abandon their plant and join the BCSA system. Also regional planning does not call for the abandonment of their plant. Therefore, the JME was designed without allowing for flow from Lyndhurst-North Arlington.

6.6.2 Rerouting Minisystems E and F - Sewers in the western portion of Carlstadt minisystems E and F,as shown on Plate 10, are presently connected to the East Rutherford Sanitary System. A Facility Plan being prepared for the Borough of Carlstadt considers the alternative of bypassing the East Rutherford System and JME Pumping Station, by pumping sewage from minisystems E and F directly to the JME force

This alternative would involve construction of a pumping station and force main from Western Carlstadt to the JME Force Main at Murray Hill Parkway and Paterson Plank Road.

If Carlstadt selects this alternative, the 2020 peak flow to the Joint Meeting Pumping Station would decrease by 2.0 mgd. As a result the design capacity of the station could be reduced from 17.5 mgd to 15.5 mgd. The difference in construction costs between a 17.5 mgd and 15.5 mgd station is minor since the differences in design are the pump impeller, the pump motor, the emergency generator and the size of the wet well. The difference in operation and maintenance costs is also minor.

As of May 1977, it does not appear that it is cost effective for Carlstadt to select the alternative of a separate pump station for minisystems E and F. However if Carlstadt does select this alternative, the size of the JME Pumping Station would be modified in final design.

6.7 Gravity Flow to BCSA - The alternative of conveying the Joint Meeting flow to the BCSA plant without pumping was also considered. The alternate would involve constructing a gravity sewer about five miles long, about 60 inches in diameter, at depths ranging from 20 to 30 feet. Alternative 7 on Plate 21 shows a possible route. The large size would be necessary because the hydraulic gradient at the BCSA plant wet well is only six feet below the gradient in the Joint Meeting influent trunk sewers. In comparison with the proposed JME project the construction cost of such an alternative would be prohibitive.

6.8 Use of the Present JM Pumping Facilities - At present, sewage is pumped through the JM plant by pumps in the large JM administration building. An investigation was undertaken to determine if the substructure of the existing building could be cost-effectively utilized as an alternative to constructing a new JME Pumping Station. It was determined that such an alternate would not be practical for these reasons:

1. It would be difficult and costly to maintain operations during construction.

2. The wet well capacity was far undersized and would require expensive enlargement.

3. All mechanical, heating, ventilating and electrical units would need replacement.

4. The building was not designed for present standards, there are no provisions for comminutors, and the pumps and motors would be below possible flood level.

5. The structural condition of the 40 year old building is dubious.

6.9 Force Main North of Paterson Plank Road - Paterson Plank Road is a heavily traveled roadway. The proposed force main construction along the southern shoulder will necessarily involve a certain inconvenience to the public. In attempting to minimize the inconvenience, this alternate force main route was evaluated.

At the intersection of Murray Hill Parkway and Paterson Plank Road, the force main would cross Paterson Plank Road near 20th Street and follow Broad Street eastward. The route would continue eastward through a section of the meadowlands, and cross Berry's Creek. The route would extend northward, near the east bank of the creek then eastward towards Dell Road and Gotham Parkway. At Gotham Parkway it would connect with the BCSA ERE force main. Alternative 9 on Plate 21 shows this alternative force main alignment.

The construction cost of this alternative was about equal to the cost along Paterson Plank Road, however the disadvantage of this alternative route was the same as was mentioned for the separate Carlstadt pumping station (Section 6.4). It would involve constructing the force main through a section designated as marshland preserve by the HMDC. It was assessed that the permanent environmental damage and disruption of the ecosystem caused by constructing a permanent easement through this environmentally sensitive habitat, would be greater than the temporary disruption caused by construction along Paterson Plank Road. The crossing of Berry's Creek near the present industries along Paterson Plank Road was also assessed to be less disruptive to the natural habitats than a crossing upstream in the marshland preserve.

7.0 Plan Selected

7.1 Views of the Public and Concerned Interests

Since the orders from the EPA and NJDEP dictate the selection of the proposed project over other alternates, a public hearing has not been held to date. At this time, no objection by the public is anticipated. In addition, the NJDEP and EPA have been involved in the evaluation and study of the Joint Meeting Extension. The three Boroughs, the Joint Meeting, and the BCSA have provided input into the planning of this project since the 1966 report. The HMDC was also consulted regarding the meadowlands and its relationship to the project.

This draft facility plan and prior Joint Meeting project reports will be made available for public inspection and a public hearing will be held in accordance with EPA requirements. After this hearing, all comments will be evaluated and incorporated into the final report. To expedite agency reviews and approvals, this draft facility plan is being submitted to NJDEP and the EPA for review and comments during the period of public hearings.

7.2 Evaluation and Ranking of Alternatives

As previously discussed, the alternatives were limited by the EPA and NJDEP orders and the Joint Meeting resolution to abandon the facility and connect to the BCSA system. However, the several alternates which were considered and evaluated during the 11 years of JM Facility Planning are presented in section 6.0. The considerations which led to the selected alternate are discussed in that section.

7.3 The Selected Plan

7.3.1 Background - The 1971 BCSA Joint Meeting Extension Project Report presented three alternates for pumping the JM sewage to the BCSA system.

Alternate A of that report is essentially the selected plan. The disadvantages of Alternates B and C are discussed in Sections 6.4 and 6.5.

In April, 1973 the Boroughs of Carlstadt and Rutherford and the Joint Meeting passed resolutions requesting that Alternate A of the 1971 project report be implemented as the preferred alternate. East Rutherford had previously planned to connect its JM area section through its municipal sewers and pumping station to the BCSA-ERE; and a portion previously in the JM area between Route 17 and Berry's Creek had been so connected. However, by letter of July 17, 1973, the East Rutherford Sewerage Authority also requested that flow from the remainder of the JM area in East Rutherford be intercepted at the Joint Meeting treatment plant site.

Based on the concurrence of the three municipalities the BCSA prepared the 1973 Joint Meeting Extension Project Report. That report detailed the financial viability of the

Alternate A project, in accordance with the State and Federal Regulation at that time. The 1973 Project Report is included with this facility plan, as Appendix C.

The decision to construct the proposed project has been upheld by the most recent NPDES permit issued to Joint Meeting (expiring June 30, 1977), which states under special condition C(1)2:

> "Final Plan. The permittee shall discontinue discharging from the the Joint Meeting-Rutherford, E. Rutherford, Carlstadt STP and shall convey all sewage flows to the Bergen County Sewer Authority as soon as the regional facilities are operable. Within thirty days of the discontinuance of its discharge, the permittee shall so notify the Regional Administrator and the State Agency."

7.3.2 Description - The selected plan provides for pumping all JM area sewage to the BSCA system for treatment, eliminating the need for the separate JM treatment facility. The pumping station will be constructed in the northwest corner of the JM plant site, near the trickling filters as shown on Plate 20. By constructing the station in this isolated corner of the plant site, the JM plant can continue to operate during construction with a minimum amount of disruption.

The 9922 foot force main will traverse flat land. From the pumping station, it will cross the railroad tracks and extend northward through a short section of industrially zoned meadowland to Branca Road. It will extend eastward about 0.1 mile in Branca Road and northward about 0.9 mile in Murray Hill Parkway. The force main will then extend eastward about 0.7 mile along the southern shoulder of Paterson Plank Road, across Berry's Creek, to Gotham Parkway where it will connect with the BCSA-ERE force main. From there, the JM sewage will flow through the ERE force main, then continue by gravity treatment to the BCSA plant through the Hasbrouck Heights and Hackensack Valley Trunk sewers. The route of the proposed JME force main is shown on Plate 19.

The BCSA planned for receiving Joint Meeting flows when constructing the Hasbrouck Heights Interceptor and the BCSA ERE force main. These sewers are capable of handling ultimate flows from JM area without future modifications. The proposed connection of the Joint Meeting Extension was planned during design of the East Rutherford Extension. A fitting was constructed on the ERE to expedite the planned connection of the two force mains.

The project includes the necessary reconstruction of the influent sewers to divert the sewage from the JM plant to the proposed JME Pumping Station. It also includes the reconstruction of the five JM meters shown on Plate 14, so that the BCSA will have a basis for billing the munici-palities. Preliminary design details of the proposed pumping station, force main and influent sewers are included in Section 8.1. The project does not include the ultimate disposition of the abandoned JM plant. This will be the responsibility of the Joint Meeting. The Joint Meeting may decide to demolish the plant and sell the land for industrial development.

7.4 Environmental Impacts of Selected Plan

7.4.1 Impacts on the Existing Environment Land Use Patterns

- Zoning for the area in which the force main and pumping station will be constructed is under the jurisdiction of the HMDC. West of Berry's Creek, the area is zoned for light industrial development. East of Berry's Creek the area is a part of the Meadowlands Sports Complex. The force main will be constructed, for the most part, along the rights of way of existing roads. Only a short portion of the force main south of Branca Road will cross a presently undeveloped section of the meadowlands, zoned for light industry. The proposed force main, therefore, will have insignificant long term effect on present or future land use patterns in the area.

Future impacts on land use in presently undeveloped areas will be minor since future developers will be aware of the force main's existence and provide for its right-of-way during development and construction.

<u>Short Term Impacts</u> - Construction of the force main along roadways in the developed areas will have short term

impacts on industries due to noise, traffic delays and dust. These impacts will not continue after completion of construction. Construction in the undeveloped areas will have some temporary impacts on the present ecosystem, however, these areas are destined for future development and these disturbances are inevitable.

Construction of the pumping station will present only minor impacts since it takes place on a previously developed site. Again, impacts will be mainly noise and dust, and will be temporary. Impacts on the small section of the meadowlands northeast of the plant will be negligible. This area is zoned for industrial use and its development is inevitable. Hence, the area is not considered to be environmentally sensitive. The point where the force main crosses Berry's Creek along Paterson Plank Road may suffer some adverse impacts. The pipeline will be constructed beneath the creek bed, and result in some temporary unavoidable disturbance of the ecosystem and pollution of the surface water. Flow in this section of Berry's Creek will not be permanently altered, enabling the ecosystem to return to its natural state upon completion of the project.

Growth Impact - Long term (secondary impacts) of induced growth may be attributable to the implementation of this project. Having adequate sewage treatment and conveyance facilities designed for flows significantly beyond those presently generated, will allow a more intensive residential and industrial development in the JM area.

Without the proposed adequate sewerage facilities, a building ban could have been imposed in the area disrupting the projected growth.

<u>Water and Sewerage Plans</u> - The JM area is served by the Hackensack Water Company. Future development will also be served by them.

The section of the meadowlands traversed by the force main is sewered by the East Rutherford Sewer Authority through the BCSA ERE to the BCSA plant. Portions of the area north of Paterson Plank Road are sewered to the JM plant. Undeveloped areas west of Murray Hill Parkway will be sewered to the East Rutherford Sewer Authority. The ultimate design capacity of the proposed JME pumping station is 17.5 mgd. This design allows for future increases of the Joint Meeting flows due to more intensive industrial and residential development.

<u>Local Ecosystems</u> - The selected project will have some temporary impacts on local stream biota and terrestrial environments. The construction of the proposed force main will disrupt aquatic life in the vicinity of the Berry's Creek crossing. The force main will cross under the creek bed, approximately 85 feet south of the Paterson Plank Road crossing. Diversion structures required for construction will temporarily disrupt the normal flow pattern in the creek. Surface water pollution will also occur due to resuspension of bottom sediments and siltation. Steps will

be taken during construction to minimize these temporary effects. Terrestrial life in the vicinity of the creek will also be affected temporarily due to construction activity. The effect of construction will be minor in comparison with the effect of present industrial and commercial activities on Paterson Plank Road, which more seriously disrupts the natural environment surrounding the creek.

Construction through the presently undeveloped meadowlands will have some minor temporary effects on the environment. These areas are not considered to be environmentally sensitive due to the industrial zoning.

Aquatic life in Berry's Creek downstream of the present Joint Meeting treatment plant outfall will benefit from the abandonment of the treatment plant. Lower organic loadings to the creek will result in higher dissolved oxygen concentrations providing better conditions for aquatic life. Lower pollutant discharges such as heavy metals, nitrogen and phosphorus will also aid in returning the creek to a more natural condition.

<u>Water Quality</u> - Implementation of the selected plan will have no long term adverse effects on water quality with the exception of those associated with lower velocities in Berry's Creek discussed in Section 6.3.2. Flow disruption and temporary surface water pollution in the already severely polluted Berry's Creek will cease as impacts upon completion of construction.

As discussed in Section 6.3.2, JM plant abandonment will have several beneficial impacts on water quality. BOD, organic nitrogen, phosphorus, COD and heavy metal loadings in Berry's Creek will be reduced when the treatment plant discharge is eliminated. This will improve water quality in Berry's Creek. Termination of sludge lagooning at the plant site will prevent further pollution of groundwater supplies. Leachate from the lagoons will be reduced after the lagoons have stabilized.

The adverse impact on the Hackensack River caused by additional discharges from the BCSA plant is minor since the additional flow from Joint Meeting is small in comparison with the flow presently treated at the BCSA plant. Discharging the JM flows to the Hackensack River is beneficial in that it will increase flow and reaeration rates, aid in dispersion of pollutants, prevent salt water intrusion, and recharge groundwater supplies downstream.

<u>Alleviation of Public Health Problems</u> - The selected plan will reduce public health problems by replacing a source of river and soil pollution by conveying the sewage from the JM area to an environmentally sound regional treatment plant.

<u>Industrial and Residential Relocation</u> - The selected plan will not cause relocation of any industries, residences or roadways. It may allow the development of industry on the site of the abandoned JM plant.

pumping station and force main, and from the possible demolition of the abandoned plant. Construction noises are expected to have minimal effects on the surrounding environment since highway traffic, railroads, aircraft, industries, and the Meadowlands Sports Complex already have high noise levels. Measures will be taken to minimize construction-related noise whenever possible. No long term increases in noise levels will occur from the pumping station's operation.

7.4.2 Irreversible and Irretrievable Commitment of Resources - In the construction and operation of the proposed facilities, a commitment of land, materials, fuel and power is required. The pumping station will be constructed at the existing treatment plant site; requiring no new commitment of land. However, construction of sections of the force main not in the roadway right-of-way will require easements. All materials used in construction represent a loss since they will have little salvage value at the end of the project life. Fuel and power used in the work are an immediate irretrievable loss. The financial investments necessary for construction and operation of the project are also irretrievable commitments.

7.4.3 Steps to Minimize Adverse Effects - Adverse environmental effects resulting from construction will be minimized by following approved construction practices. Adequate supervision of construction, and periodic inspections by State and Federal personnel will insure that the contractor adheres to the specifications and regulations.

These sections of the Contract Documents summarize procedures to minimize adverse effects:

Operations Maintained - It is essential to public health that the operations of the existing sewerage facilities be maintained. No major interruption of operations due to construction is anticipated.

Minimum Noise - The contractor will use every effort and means possible to minimize or eliminate objectionable noise caused by his operations. The contractor will provide working machinery, designed to operate at the lowest practical noise level.

Maintaining and Safeguarding Traffic - The contractor will erect temporary barriers, fences, warning signs, lights, and signals required to protect traffic. It is expected that the construction will have minimal effect on local traffic. Free access will be maintained to every fire hydrant.

Safety Precautions - To the extent required by law, public authority or local conditions, the contractor will adequately protect traffic and adjacent property. He will also provide and maintain all passageways, guard rails, fences, barricades, lights and other facilities necessary for protection.

Drainage - The contractor will provide all equipment required to remove and dispose of water from trenches, tunnels and excavations for structures. Adequate facilities, approved by the engineer, will be provided for the interception of suspended matter from the pump discharge before it is discharged into the existing drainage system.

Dewatering - The contractor will provide approved settling basins and sumps to catch and temporarily hold water pumped from excavations containing mud, clay, sand or other material in suspension. Such basins will have sufficient capacity to provide adequate storage time for the settlement of the suspended matter. The settled material will be removed frequently and disposed of as approved.

Storage and Disposal - Excavated material in excess of that required for backfill, fill or other purposes, including any stored surplus and material unsuitable for backfill or fill, such as organic matter, boggy, peat humus, wood, rubbish, waste, ashes, cinders and rock and stones whose greatest dimension exceeds six inches shall be disposed of by the contractor at his own expense in designated areas as approved by the engineer.

Clean Up - The contractor will keep all roadways and sidewalks and other areas adjacent to the work clear of refuse at all times. Upon completion of the work the areas will be left in a neat condition. A self-loading motor sweeper with spray nozzles or other approved methods including chemicals or water sprinkling will be used when required for the protection of property and workmen against dust. The accumulation of dust will be minimized to prevent a concentration which tends to obstruct vision. The site as well as access routes to the site and any other areas disturbed by the Contractor's operations will have a neat, orderly, workmanlike appearance.

8.0 Preliminary Design and Cost Estimates

8.1 Design Flow

8.1.1 Flows

8.1.11 1980 Flow - The design capacity of the pumping station was determined by estimating the sewage flows through the forty year design period. Flow projections begin in 1980. As developed in Section 5.3, based on population projections in the 1973 Project Report and HMDC reports on the meadowlands area and using a per-capita consumption of 100 gpd, the average domestic flow for 1980 was estimated at 2.85 mgd. Present industrial flows were determined from 1974 consumption records and sewage discharges. It was estimated that this flow will steadily increase from 1976 until 2010 when industrially zoned land will discharge 2500 gpd/acre. By interpolation the 1980 average industrial flow was estimated at 0.98 mgd. Thus the total average flow to the pumping station in 1980 was estimated at 3.83 mgd. The 1980 peak flow, 10.0 mgd, was determined from the standard peak to average design ratios for BCSA sewerage facilities included as Table 10.

8.1.12 2020 Flow - The domestic and industrial flows for 2020, the end of the planning period, were estimated by the methods described in Section 5.3. Average domestic flow was evaluated at 4.73 mgd while average industrial flow equalled 2.63 mgd for a total average flow of 7.36 mgd. Based on the peak to average ratio, the peak flow was determined to be 17.5 mgd, the ultimate design capacity of the pumping station.

8.1.2 Pumping Station Structure

8.1.21 Superstructure - The pumping station structure will be constructed, with external dimensions of 38.5' by 40.0', to accomodate all required equipment and to provide adequate space for repairs, maintenance and operation. The superstructure will be of brick construction and extend about twelve feet above the ground surface. The entrance will be sized to provide easy access to the equipment. The area surrounding the pumping station will be landscaped.

8.1.22 Drywell - The drywell (34.5' long, 21.5' wide and 13.5' deep) will house the three sewage pump units and the header which conveys the flow to the force main. A stairway from the main level will provide access to this area.

8.1.23 Wetwell - The effective capacity of the wetwell, 38,300 gal was designed to provide 7.5 minutes detention, for the estimated 2020 average flow of 7.36 mgd. A dividing wall with a controlled orifice will separate the wetwell into two chambers to permit cleaning. Air blowers will be provided to agitate the sewage in the wetwell and prevent sedimentation and septicity. Plate 17 indicates the proposed wetwell cross section and capacity.

8.1.24 Comminutor Room - Sewage will enter the pumping station comminutor room through a new 42-inch influent sewer (section 8.1.5) Two comminutors and a manually cleaned bar rack will be in this room. Access to this room will be by a stairway from the main level.

8.1.25 Foundation - The foundation for the station will be constructed of reinforced concrete, reaching a depth of 44 feet from the main floor to the base of the wetwell. The foundation will probably be built on piles since the soil in the area is filled marine tidal marsh. Construction of the present JM treatment plant in 1939 required this type of foundation support.

8.1.3 Flow Route Through the Pumping Station

Sewage will enter the proposed pumping station through the proposed 42" influent sewer. Two comminutors will shred the solids and debris in the flow to acceptable size before the sewage flows into the wet well. One comminutor can handle average flow in the event of problems to the other. If necessary, flow can bypass both comminutors through a channel equipped with a manually cleaned bar rack.

Two twelve-inch non-clogging pumps will convey flow from the wetwell. These alternately operating pumps will be sufficient for initially anticipated flows. A third pump will be added at a later date to develop the peak capacity of the station. Water level sensors in the wetwell will control the pumping cycle.

A ball valve on the discharge side of each unit will protect the pumps from water hammer. A flow meter will measure the total rate through the station. After passing through the flow meter the sewage will exit the pump station through the 27-inch force main.

8.1.4 Equipment

8.1.41 Comminutor - Two comminutors will be provided in the pumping station. For initial sewage flow rates only one is required. In 1990 the second comminutor will be installed for the projected increased flows. The comminutors will be hydraulically driven, permanently lubricated and protected from flooding.

8.1.42 Bar Rack - The manually cleaned bar rack will be sized to handle 50 percent of the design peak capacity of the station. The rack is hydraulically oversized about 25 percent to compensate for clogging. This bar rack enables one comminutor to be bypassed when repair or cleaning is required.

8.1.43 Sewage Pumps - The station will ultimately be equipped with three pumps to handle the 17.5 mgd peak flow. Two pumps, alternately operating, will provide sufficient hydraulic and standby capacity to convey the peak flows anticipated until 1990. At that time another will be added so that two pumps are operating with one in reserve. All three pumps will be 12" non-clogging vertical drive centrifugal pumps. The initial pumps will operate at two speeds while the third will operate at a constant speed. Plate 18 shows the system head curve for this station.

8.1.44 Pump Motors - The motors to drive the sewage pumps will be a vertical shaft, high efficiency type. Each will deliver 250 horsepower for the range of hydraulic conditions anticipated at the station. The motors will be capable of operating continuously at the required pump speeds.

8.1.45 Pump Control Unit - The pump control unit will contain all equipment and controls required to automatically control the operation of the sewage pumps and provide water level indication and alarms.

8.1.46 Standby Generator - A diesel driven 500 KW electric generator will provide power to the station in the event of a power failure. Automatic controls and fuel storage will also be installed.

8.1.47 Flow Meter - A magnetic flow metering system will be installed to measure flow through the pump discharge header. The system will include a transmitter and receiver to continuously record flow rates. The meter will be insensitive to fluctuations in conductivity due to changes in sewage composition.

8.1.48 Air Blower System - The air blower system will be sized for the wet well volume. It will be capable of operating continuously, 24 hours a day, to agitate sewage in the wet well and prevent sedimentation.

8.1.49 Miscellaneous - All valves, piping and fittings required for the operation and maintenance of the pumping station will be supplied. Other required equipment such as the manlift, hoist, sump pump, etc., will also be installed.

8.1.5 Influent Sewers

Two points of interception are required to divert the sewage flow from Joint Meeting treatment plant to the proposed pumping station. Two alternate schemes for the alignment of the intercepting influent sewers were developed. The first alternate involves the shortest length of pipe and lowest construction cost. The second involves a slightly longer route which would make more of the JM property available for redevelopment. The preferred alternate will be selected at the time of final design.

In the first alternate, flow from Rutherford will be intercepted at the existing junction manhole directly upstream of the raw sewage pump wet well. This manhole would be modified by plugging the existing Carlstadt-East Rutherford 36 inch inlet, by plugging the outlet sewer and by providing a 30 inch outlet. From this manhole, a 30" interceptor would convey sewage northward 250 feet to the new junction manhole. Flow from Carlstadt and East Rutherford will be intercepted on the 36 inch trunk sewer 40 feet north of the center line of Highland Cross. A new manhole over the Joint Meeting trunk sewer and a short 36 inch interceptor would divert the flow to the new junction manhole. A 42 inch sewer would then convey the entire JM sewage flow about 100 feet from the junction manhole to the pumping station. A 36 inch Joint Meeting trunk sewer downstream of the intercepting manhole will be plugged and abandoned.

In the second alternate flow from Rutherford will be intercepted on Borough Street near the JM plant property line. The flow would be diverted northward in a 30" interceptor along the property line to a point 40 feet north of Highland Cross on the existing 36" JM trunk sewer which now conveys the flow from Carlstadt and East Rutherford. There, a junction manhole would be constructed on the JM trunk to combine and divert the flows to the proposed pump station through a new 42" interceptor.

For each alternate, the sewer sizes were based on these criteria:

1. A minimum velocity of two feet per second flowing full.
2. A Kutter's friction factor n = 0.013.

3. The peak to average ratios in Table 10, used for all BCSA sewerage facilities.

Plate 20 shows the two alternate influent sewer alignments for diverting the Joint Meeting sewage to the pumping station.

8.1.6 <u>Force Main</u>

The BCSA will construct the Joint Meeting Extension Force Main with 27 inch reinforced concrete pipe, 9922 feet from the proposed pumping station to the existing 36 inch East Rutherford Extension force main in Carlstadt. A wye fitting was provided on the ERE force main at the proposed point of connection to facilitate construction. Plate 19 shows the selected route of the proposed force main.

A present worth cost effectiveness analysis was performed to select the force main size. Based on all construction costs, current electric power cost, a twenty year planning period, a 6 1/8 percent discount rate, and the force main smoothness coefficient "c" decreasing from 130 to 100 through the planning period; both the 24" and 27" diameters were competitive. Based on the extra salvage value of the 27" pipe, for being adequate to convey the peak JM flow through the end of the 40 year design period, the 27" size was determined to be most cost effective.

Air release and vacuum valves will be provided at the high points in the line. Water hammer investigation for the force main between will be included in the final design. Dynamic loading and other pipe design criteria will be evaluated. Plate 18 shows the system head curve for the proposed facility.

8.1.7 Metering

Metered flows will provide the basis for the BCSA to charge each of the three municipalities. Authority Meters will be installed on sewers at the municipal boundaries as a part of the project. The economics of rehabilitating the five abandoned Joint Meeting meter chambers (section 4.3.22) versus constructing new chambers will be determined during final design. The sewage flows will be continuously metered by Parshall flumes or similar devices. The flow levels sensed in the flume will be transmitted to a recorder-totalizer, mounted on a pedestal at street levels.

8.2 Summary of Cost Estimate

8.2.1 Construction Costs

Costs for the proposed project were estimated for 1976 using an ENR of 2850. These costs have been evaluated as follows:

Meters	$ 50,000
Influent Sewers	$ 137,000
9,922 L.F. 27" Force Main	$1,414,000
Pumping Station	$1,626,000
Total	$3,227,000

Adding 10 percent to the cost of the project for contingencies, $323,000, yields a total 1976 cost of $3,550,000. Since construction of the project will occur between 1979-1981, the total estimated 1976 cost was increased 30 percent to $4,615,000. This price does not include office and field supervision, preparation of an operation and maintenance manual and other costs involved in the Step III work. A value of $625,000 was estimated for these items, increasing the total cost for the Step III Grant to $5,240,000. These Step III Grant costs are summarized in Table II. Any costs involved with the ultimate disposition of the abandoned JM plant are not included. This will be the responsibility of the Joint Meeting.

8.2.2 Operation and Maintenance Costs

The annual costs for operating and maintaining the JM force main and pumping station were estimated for 1976 prices. The expenses for operation and maintenance include these items:

utility costs for electricity and gas
salaries of maintenance personnel
equipment parts and repairs
tool cost and maintenance
cost of maintenance transportation
miscellaneous supplies

Administrative costs were not included in these estimates. For the initial pumping facility, which is sufficient to handle flows from 1980 through 1990, the average annual cost was estimated at $62,000. In 1990 the pumping station capacity will be expanded to ultimate capacity. From 1990 until 2000, the end of the planning period, the operating and maintenance cost is estimated to average $75,000 per year.

8.2.3 Construction Schedule

Preliminary design of the pumping station and force main is completed. This draft Facility Plan, available for public, EPA and DEP review in May 1977, will be followed by a public hearing in July. Comments from the public, the municipalities, the Joint Meeting or the BCSA received up to 30 days after the hearing will be incorporated into the final Facility Plan. The EPA and DEP will be kept informed of these comments during this period.

Comments and changes in the draft suggested by the EPA and DEP will also be included in the final report. Approval of the draft Facility Plan, which will generate the Step II Grant funds required for the preparation of contract plans and specifications for the pumping station and force main, is anticipated by September. Publication of the final report will follow approval of the draft.

Final design should be completed about 9 months after the Step II funds are granted. State and Federal review of the plans and specifications should require 3 months after submission. After approval Step III Grant funds required for construction will be available. The interval between advertising and awarding the contract can be limited to two months. Construction of the pumping station and force main will take about two and one half years. The required rehabilitation of the sewer system to eliminate excess infiltration/inflow should proceed concurrently with construction of the pumping station and force main. Reduction in the time for Federal and State review is the only means of accelerating this schedule.

9.0 Arrangements For Implementation

9.1 Institutional Responsibilities

9.1.1 Organization and Responsibility

The proposed Joint Meeting Extension Project directly involves these five organizations responsible for segments of the sewer system:

1. Bergen County Sewer Authority (BCSA)

2. Rutherford-East Rutherford-Carlstadt Joint Meeting, (JM)

3. Borough of Rutherford

4. Borough of East Rutherford/East Rutherford Sewer Authority

5. Borough of Carlstadt/Carlstadt Sewer Authority.

The BCSA will be responsible for the construction, administration, operation and maintenance of the pumping station and force main. Authorization to perform these functions was established by the Board of Chosen Freeholders of Bergen County in 1947 when the Bergen County Hackensack River Sanitary Sewerage District and the Bergen County Sewer Authority were created. The enabling legislation provided for the Authority to construct, administer, operate and maintain trunk sewers, intercepting sewers and sewage treatment facilities to eliminate pollution of the Hackensack River and its tributaries. The Authority is a separate corporate entity operating under an Act of the State Legislature, Chapter 123, of the Laws of 1946. This Act gives the Authority power to enter into contracts with municipalities and industries within or outside its District for the construction of the necessary trunk and intercepting sewers and treatment plants and for the payment of the costs of providing such facilities.

In 1938 the Boroughs of Carlstadt, East Rutherford, and Rutherford established the Joint Meeting as a regional solution to construct a facility providing the required secondary treatment. The JM was empowered to finance, construct, administer, operate and maintain a treatment plant and trunk sewers necessary to serve the three Boroughs. At present the JM is responsible for the treatment of sewage from the service area; however, the NJDEP and the EPA have ordered the JM to connect to the BCSA system. After the proposed project is constructed, the JM will be responsible for the operation and maintenances of its trunk sewers and interceptors and ultimate disposition of the abandoned JM Plant.

As in the past the Boroughs of Rutherford, East Rutherford represented by the East Rutherford Sewer Authority and Carlstadt represented by the Carlstadt Sewer Authority will operate and maintain their respective municipal sanitary systems.

9.1.2 Resolutions of Plan Acceptance

In 1975 the Joint Meeting and the Boroughs of Rutherford, East Rutherford and Carlstadt signed contracts with the BCSA. Construction of the proposed project will enable the Authority to treat flows from the service area and fulfill the conditions established in the contract. Copies of these agreements are included as Appendix F.

9.1.3 Joint Meeting Sewer System Regulations

9.1.31 Introduction - The development of industrial cost recovery and user-charge systems for the JM service area is presently being conducted under the BCSA's overall Industrial Cost Recovery and User Charge Study.

This study is obtaining data to develop and implement Sewer Use and Pre-treatment Regulations, and is determining methods to calculate and process User Charges and Industrial Cost Recovery Charges as required by Federal law. This program will develop regulations for the quality of sewage discharged to the system, and assure equitable allocation of capital, operating and maintenance costs.

9.1.32 Development of Sewer Use and Pretreatment Regulations - The Joint Meeting municipalities must control the quantity and quality of sewage discharged into the sewer system to maintain the desired performance level at the BCSA treatment plant. To satisfy the NPDES permit requirements, the municipalities need to require certain industries to periodically submit data on pretreatment and discharges. Regulations will be established to assure achievement of these objectives. The development of these regulations will generate a number of meetings with both the public and industry.

9.1.33 Development of User Charge System - This work requires examination of sewage data for residential, commercial and industrial discharges. Flow and constituent loadings will be established and related to plant and sewer system design; forming a basis to apportion the annual charges for operation, maintenance and local capital costs. Regulations and procedures for economically and effectively implementing this charge will be determined.

9.1.34 Development of an Industrial Cost Recovery System - Analysis of sewage quantity and quality from industrial discharges is required to provide basis for apportioning the Federal grant funds to the BCSA plant. Regulations and procedures for implementing this charge will also be evaluated.

9.1.4 Federal Requirements for Grants

Approval of grants for sewerage works improvements requires at least:

1. A plan to effect the cost-effective reduction of excessive infiltration and inflow. An analysis and proposed program is included in Section 4.3, Infiltration and Inflow.

2. The pretreatment of industrial wastes; where such wastes could be detrimental to the operation of

the sewage treatment plant. The BCSA and JM municipalities have enacted a modern industrial waste control ordinance.

3. Implementation of a user charge system to assure that each recipient of waste treatment service pays its proportionate share of the operation and maintenance costs.

4. Implementation of an industrial cost recovery system to provide for equitable assessment of costs to industrial wastes dischargers corresponding to the cost of waste treatment based on the volume and strength of the industrial, domestic, commercial and other waste discharges treated.

User Charges - Federal rules and regulations concerning user charges are included in Appendix J. The following requirements and interpretations are pertinent:

1. The EPA will withhold no less than 20 percent of the eligible Federal grant unless the grantee has completely developed an approved user charge system.

2. On July 2, 1974, the Comptroller General of the United States overruled an earlier EPA decision

and held that the use of ad valorem taxes would not satisfy the user charge requirements of the Federal Water Pollution Control Acts Amendments of 1972. The matter is now before Congress in the form of a proposed amendment to the Act which, if adopted, would reverse the Comptroller General's decision. However, the amendment would still require the imposition of necessary surcharges to insure that each user pays its appropriate share of the cost. Ad valorem taxes may still be used by municipalities to collect local debt service charges which are exempt from the EPA user charge requirements.

3. Under the EPA user charge requirements, operation and maintenance costs (capital costs are excluded) should be apportioned among the users in accordance with each respective user's contribution to the total wastewater loading of the treatment works.

4. User charge payments from domestic and industrial discharges are to be made in accordance with a local user charge ordinance. The ordinance may establish user classes for groups of users displaying similar wastewater characteristics and may impose rates on any basis which can be shown to produce a reasonable proportionality between each local user's share of the operation and

maintenance costs and the municipality's total wastewater loading. It may appear appropriate, for example, to charge apartments on the basis of the number of rooms;schools on the basis of number of students per day; restaurants on the basis of the number of seats; and domestic users on the basis of water meter readings.

5. Industries must be charged on the basis of their respective proportional shares of the wastewater loading of the treatment works, considering both volume and quality. In this regard, the EPA grant regulations state that quantity discounts to large volume users are unacceptable.

Industrial Cost Recovery - The pertinent Federal legislation and rules and regulations concerning industrial cost recovery are also included in Appendix J. The following requirements and interpretations are pertinent:

1. Industrial Cost Recovery requires industries to pay their equitable share of the Federal grant which was received for the capital costs of the construction of the treatment works.

2. An approved system of Industrial Cost Recovery must be enacted prior to receipt of more than 80 percent of any grant.

3. Some commercial establishments, such as small hotels and stores, may be excluded from Industrial Cost Recovery requirements if those establishments introduce primarily domestic wastes.

4. Strength of pollutants contained in an industry's discharge as well as volume must be considered when computing the cost recovery charge. Only those industrial users that discharge sewage in large volumes or high pollutant strength need be monitored on a routine basis.

5. Cost recovery applies to the industries' share of the federal portion of the capital costs of the treatment works defined as: "Any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of liquid nature to implement section 201 of the Act, or necessary to recycle or reuse water at the most economical cost over the useful life of the works, including intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment and their appurtenances; extensions, improvements, re-modeling, additions, and alternations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including

site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal or residues resulting from such treatment; or any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems."

6. It appears that industrial cost recovery charges should be recomputed annually to equitably distribute charges and account for changes in waste characteristics.

7. The industrial cost recovery period is 30 years, or the useful life of the facilities, whichever is less.

8. The amounts recovered are required to be distributed as follows:

   50% + interest to U.S. Treasury;

   50% + interest to Bergen County Sewer Authority for expansion or reconstruction of treatment works.

9.2 Implementation Steps

The NPDES permit issued by the EPA and a state court order have directed the Joint Meeting to cease discharging and connect to the BCSA system. At present Carlstadt, East Rutherford, Rutherford and the JM have signed agreements with the BCSA to meet the state and federal directives. Preliminary plans are completed and a Step II Grant Application for funds to complete the design will be submitted and should be approved upon acceptance of this Facility Plan. The design of the pumping station and force main will require about 9 months. The Step III Grant Application for construction monies will follow. The actual construction of the facilities will take about two and one half years.

9.3 Operation and Maintenance

9.3.1 Operation and Managerial Responsibility

It is important that the Joint Meeting Extension pumping station and force main be properly operated and maintained to insure efficient operation and to avoid costly and hazardous breakdowns. Upon construction, the proposed facility will be included in the BCSA continual operation and maintenance program. The program includes these items:

1. daily inspection to assure proper motor and pump operation;

2. scheduled equipment checks by an instrument technician, electrician and engine mechanic to maintain and service specific units;

3. preventative maintenance by removing worn equipment to insure continuous operation;

4. emergency service to repair or replace equipment which has failed;

5. records indicating operating data and maintenance work.

Presently BCSA personnel operate and maintain 11 pumping stations and 140 Authority meters. The staff is well trained in maintenance and repair of the Authority facilities. This training and experience will prove invaluable in providing continuous dependable operation of the JME pumping station.

9.4 Financial Requirements

9.4.1. Project Costs

Cost estimates for the proposed project were subdivided into three categories which correspond to the three stages of federal funding. Facilities Planning, a Step One Grant, was estimated to cost $365,000. The Step Two Grant necessary for final design of the project was estimated at $785,000. The pumping station and force main are scheduled to be constructed between 1979 and 1981. A Step III Grant is required to fund this construction. Preliminary cost estimates indicate the facility may cost $5,240,000 to construct. The total cost for the three necessary grants is $6,390,000. A detailed breakdown of the costs associated with each step is presented in Table 11. Not included in these costs is possible sewer system rehabilitation which may cost an additional $700,000 (1976 prices).

9.4.2 Sources of Funds

9.4.21 Federal Grants - In accordance with provisions of the Water Pollution Control Act of 1966 and its amendments of 1972, construction of treatment facilities and trunk, intercepting and outlet sewers which starts after October 1972 is eligible for Federal Grants. These Grants could provide as much as 75 percent of the grant-eligible costs. At present, a Step I Grant application for facilities planning was estimated at $365,000 of which $273,750 is eligible for the grant. The preliminary cost estimate for Step II, final design, and Step III, construction, are $785,000 and $5,240,000 respectively. Applications for federal funds of as much as 75% of the eligible costs will be submitted for these phases of the project.

9.4.22 State Grants - Presently no state funds have been allocated for this project. However, if funds become available the share of costs to the Authority will be reduced accordingly.

9.4.23 Bond Issues - In accordance P.L. 1946, C 123 as amended and supplemented, the Authority has the power to issue bonds to cover costs not funded by federal or state grants. For the preliminary design phase, Step I, the Authority share of the cost is estimated at $91,250, without state monies. The Authority will also share the Step II and Step III costs. All these costs will be covered by an Authority bond issue or other available funds.

9.4.24 Intent to Comply with User Charge and Industrial Cost Recovery Programs - The Boroughs of Carstadt, East Rutherford and Rutherford have signed contracts for their flows to be treated at the BCSA plant in Little Ferry. In signing the contracts the Boroughs have agreed to comply with the regulations established by the Authority. These regulations include a user charge and industrial cost recovery program which is presently being developed.

The industrial cost recovery program for this project will require that industries in the system repay an equitable share of the Federal Grant. This share will probably be based on the flow BOD and suspended solids contributed by the industries. This amount will be repaid over a 30-year period.

The user charges being developed include costs for operation and maintenance of the system. The annual operation and maintenance costs for all Authority owned facilities are distributed to the municipalities based on their flow contribution and sewage flow characteristics.

9.4.25 BCSA Service Charge - The BCSA annually computes the rate to be charged to the municipalities for their metered sewage flow. This service charge provides sufficient income to pay all BCSA expenses including operating maintenance and administrative expenses and debt service on outstanding bonds issued for previous Authority projects. The present charge to the municipalities served by the Authority is $330.64/mg. Carlstadt, East Rutherford and Rutherford will be subject to the service charge for JM flows at the time the JM Extension becomes operational.

An annual debt service charge for the Joint Meeting Extension Project will be distributed to all participants within the district. The Authority bond issue is dependent on the amount of Federal and State funds available. With Federal funds for 75% of the project costs and no State aid, the required Authority bond issue is estimated at $1,600,000. If State funds are available the bond issue would be reduced about 50% to $800,000. Using an interest rate of 6 1/8% uniform annual series and 40-year maturity for the bond issue, the annual debt service charge would be $110,000 assuming no State Grant and $55,000 with a State Grant.

The annual operation and maintenance costs for the proposed Joint Meeting Extension pumping station and force main were estimated for the first ten years at $62,000 (1976 prices). This annual cost will also be distributed to each participant based on metered flow conditions.

The equitable distribution of Authority expenses between the municipalities and industries will be based on 1) a common rate for the quantity of flow and 2) a surcharge based on the characteristics of the industrial discharges. The common rate billed each of the municipalities presently served by the Authority is $330.64/mg of sewage discharged to the system. Because of the additional revenues generated from Joint Meeting flows will exceed the additional annual expenses, the common billing rate for each municipality including Carlstadt, East Rutherford and Rutherford will decrease. Based on the present billing rate, present flows and estimated project expenses the rate would decrease either $11.92/mg or $14.71/mg contingent on state funding. Therefore the annual cost to each BCSA municipality exclusive of industrial surcharge would be:

BCSA Charge = (Total annual Flow-mg) x ($315.93 rate with State Aid for JME) or x ($318.72 rate with no State Aid for JME)

Based on present flows, these annual costs would be billed to the three Joint Meeting municipalities:

	Daily Flow (mgd)	Yearly Flow (mg)	BCSA CHARGE With State Aid	BCSA CHARGE No State Aid
Carlstadt	1.42	518	$ 164,000	$ 165,000
East Rutherford	1.30	475	$ 150,000	$ 151,000
Rutherford	1.01	369	$ 116,000	$ 117,000

Based on the estimate that a typical household discharges 0.10 mg to the system yearly, the monthly charge to a typical residential customer would be:

1. Rate with JME Project receiving State Aid:
   (315.93) (0.10) /12 = $2.63/month

2. Rate with JME Project receiving no State Aid:
   (318.72) (0.10) /12 = $2.66/month

10.0 Summary of Environmental Considerations

The proposed pumping station and force main which will convey Joint Meeting flows to the BCSA system for treatment represents the most environmentally sound alternative. Construction of the proposed facility will eliminate most of the pollutant loading to Berry's Creek and consequently improve the water quality. Present sludge lagooning procedures will cease and impacts to the local ecosystem will decrease. As the sludge stabilizes in these lagoons the public health hazard will diminish. By constructing the pumping station on the existing plant site and the force main along existing roadways and rights of way the adverse primary impacts will be minimized and temporary. The Joint Meeting Extension does not disturb any historically, archaeologically or environmentally significant areas. Since the area is zoned for light industry and sports complex by the HMDC, the overall environmental sensitivity is limited.

In the design of the East Rutherford Extension force main, the BCSA provided for future expansion of the system by providing sufficient capacity to convey the Joint Meeting flow. A JME connection point was included on Gotham Parkway in the construction of the BCSA ERE force main. There will be limited other impacts on the existing BCSA system.

The proposed project has certain adverse primary impacts which are temporary in nature. Construction of the Berry's Creek Crossing will disturb the waterway and local ecosystem but this impact will cease after completing the project. Traffic delays, noise, dust and other construction related impacts will result from the force main construction in the roadways in this industrial area. An irretrievable commitment of energy and resources will be required for construction and operation of the facilities.

An environmental assessment of the various alternatives which were considered is included in Sections 6.0 through 6.9 of this Facility Plan. In considering the various alternatives the impacts of the proposed project were also assessed. A detailed evaluation of the environmental impacts involving only the selected alternative is presented in Section 7.4.

TABLE 1

COMPOSITE ZONING, JULY 1975

Zone	ACRES Carlstadt	 East Rutherford	 Rutherford	 TOTAL
Single Family	10	-	340	350
One and Two Family	330 (20)	-	60	390 (20)
Garden Apts. & Townhouses	-	160	40	200
High Rise Apts. or Convention Center	-	-	290 (290)	290 (290)
Commercial	50	40	100 (10)	190 (10)
Light & Industrial Office	240 (70)	260 (20)	200	700 (90)
Heavy Industrial	20	-	-	20
Other	*30 (30)	-	**100 (100)	130 (130)
TOTAL	680 (120)	460 (20)	1130 (400)	2270 (540)

NOTE

Acreage in parenthesis is not presently developed.

* Zoned for open space by HMDC.

** Zoned as a portion of Berry's Creek center by HMDC.

TABLE 2
JOINT MEETING
PRESENT AVERAGE SEWAGE FLOW

MUNICIPALITY*	DOMESTIC (mgd)	INDUSTRIAL (mgd)	INFIL-TRATION (mgd)	INFLOW (mgd)	TOTAL (mgd)	JOINT MEETING POPULATION	DOMESTIC PER CAPITA FLOW (gpd)
Carlstadt	0.49	0.42	0.50	0.01	1.42	6800	72
East Rutherford	0.40	0.34	0.55	0.01	1.30	5800	69
Rutherford	0.70	0.03	0.26	0.02	1.01	9900	71
Service Area Total	1.59	0.79	1.31	0.04	3.73	22,500	71

*Includes only sections tributary to Joint Meeting

TABLE 3

SUMMARY OF SEWER LENGTHS (1)

Municipality	Minisystem	Municipal Sewers (miles)	Joint Meeting Sewers (miles)	Total Sewer Length (miles)
Carlstadt	A	0.9	0.1	1.0
	B	3.1	0.5	3.6
	C	0.9	-	0.9
	D	3.9	-	3.9
	E	2.1	0.2	2.3
	F	1.7	0.1	1.8
Subtotal		12.6	0.9	13.5
East Rutherford	G	1.0	0.5	1.5
	H	1.6	0.7	2.3
	I	3.3	-	3.3
	J	2.5	-	2.5
	K	1.3	-	1.3
	L	2.5	-	2.5
Subtotal		12.2	1.2	13.4
Rutherford	M	3.4	-	3.4
	N	2.2	-	2.2
	O	1.8	-	1.8
	P	1.7	-	1.7
	Q	1.6	-	1.6
	R	3.9	-	3.9
	S	1.7	-	1.7
	T	1.8	-	1.8
	U	1.0	-	1.0
Subtotal		19.1	-	19.1
Service Area Total		43.9	2.1	46.0

(1) Tributary to Joint Meeting, excluding building connections

TABLE 4

SUMMARY OF PRESENT WORTH BENEFITS FROM EXTRANEOUS FLOW REMOVAL (1)

		Inflow	Infiltration
		(gpd average flow removed) (2)	
1.	Possible deferred plant expansion	$ 0.90	$0.90
2.	Reduced treatment plant operating costs	0.40	0.40
3.	Reduced Pumping Station Operating Costs	0.10	0.10
4.	Miscellaneous (3)	0.50	0.50
	Subtotal	$1.90	$1.90
5.	Reduced Capacity of Pumping Station	$5.00	$0.20
6.	Miscellaneous (4)	$12.00	$0.50
	Subtotal	$17.00	$0.70
	TOTAL	$18.90	$2.60

(1) Based on 20-year planning period, using a 6-1/8% interest rate without allowance for general inflation.

(2) Based on total of 1.30 mgd of average infiltration and 0.04 mgd of average inflow in the system.

(3) a. Decreased foundation material washouts.
b. Reduced abrasive solids entering system.
c. Increased plant effluent quality.

(4) a. Deferred capacity increase of municipal sewers.
b. Decreased bypassing during severe wet weather conditions
c. Reduced sewage flooding of streets, yards, basements, and sewer structures.

TABLE 5

BENEFIT FROM DEFERRING EXPANSION OF BCSA TREATMENT PLANT CAPACITY FROM 75 TO 100 MGD (1)

Item	Present Cost (million) $ (2)	Year Required and Present Worth: With no Flow Reduction (yr.)	With no Flow Reduction (million $)	With 75.6 mgd Reduction (yr.)	With 75.6 mgd Reduction (million $)	Present Worth of Deferral (million $/5.6 mgd)	Present Worth of Deferral ($/gpd)
Construction Cost	14.0	4	11.0	8	8.7	2.3	0.41
Less Salvage Value at 20 Years (3)	-	-	-1.1	-	-1.9	0.8	0.14
Engineering and Legal Fees	3.5	2	3.1	6	2.4	0.7	0.12
Increase in Fixed Operating & Maintenance Costs	0.5 per annum	5	3.6	9	2.3	1.3	0.23
Total			16.6		11.5	5.1	0.90

(1) Based on 6-1/8% interest rate, 20-year planning period, 1.4 mgd annual flow increment no allowance for general inflation

(2) Excludes cost increases for expanding additional wastewater treatment facilities needed to meet 1983 standards.

(3) Based on 20 year design period, straight line depreciation.

TABLE 6

BENEFIT FROM REDUCED PLANT OPERATING COSTS

BCSA BUDGET ITEMS	Present Annual Cost	% of Cost Proportional to Flow	Annual Flow Proportional Costs
Chemicals	$ 280,000	100	$ 280,000
Sludge Disposal	500,000	75	375,000
Power	1,110,000	75	833,000
Fuel, Lubricants	60,000	50	30,000
Maintenance & Analysis	450,000	10	45,000
Overhead (3)	2,300,000	0	0
Total Annual Cost	$4,700,000	33.3	$ 1,563,000
Adjustment Factor (4)			1.35
Adjusted Annual Cost			$ 2,110,000
Present Worth Factor			11.35
Present Worth ($/60 mgd)			$24,000,000
Present Worth ($/gpd)			$ 0.40

(1) Based on 60 mgd BCSA plant flow.

(2) Includes salaries, employee benefits, administration, insurance, office, lab, equipment, utilities and depreciation.

(3) To account for higher costs associated with future advanced wastewater treatment and proportional higher energy and chemical costs.

(4) 6-1/8% interest rate, 20-year planning period, no allowance for general inflation.

TABLE 7

COST OF CLEANING AND TELEVISING SSES PHASES

	OPERATION	$/ft	($/mile)
1.	Cleaning & Threading winch cables by jetting	0.40	(2,100)
2.	Televising to assess:		
	a) Joint defects	0.25	(1,300)
	b) Other defects	0.10	(550)
3.	Mobilizing & demobilizing camera between manholes	0.25	(1,300)
4.	Engineering including supervision & field report preparation	0.30	(1,600)
5.	Contingencies	0.10	(550)
6.	TOTAL	1.40	(7,400)

TABLE 7A

COST OF REMOVING JOINT INFILTRATION BY GROUTING

	OPERATION	$/ft	($/mile)
1.	Cleaning & Threading winch cables by jetting	0.40	(2,100)
2.	Mobilizing & demobilizing & Packer		
	a) between manholes	0.30	(1,600)
	b) between joints (1)	0.70	(3,700)
3.	Air-testing each joint	1.10	(5,800)
4.	Grouting joints found defective (2)		
	a) labor	0.90	(4,800)
	b) material	0.90	(4,800)
5.	Engineering including supervision & field report preparation	0.35	(1,800)
6.	Contingencies	0.50	(2,600)
7.	TOTAL	5.15	(27,200)

(1) Estimating 2-1/2 - 3 foot joint spacing

(2) Estimating 35% of joints fail air test and require grouting

TABLE 8

SUMMARY OF PROPOSED PHYSICAL INSPECTION PROGRAM

MUNICIPALITY	MINI-SYSTEM	AVERAGE INFILTRATION (1,000 gpd)	TOTAL LENGTH (miles)	UNIT AVG. INFILTRATION (1,000 gpd/mile)	LENGTH PROPOSED FOR PHYSICAL INSPECTION (miles)
Carlstadt	A	244	1.05	232	1.05
	B	41	3.56	12	2.38
	C	1	0.88	1	-
	D	45	3.93	11	2.44
	E	-	2.31	-	-
	F	164	1.82	90	1.82
Subtotal		495	13.55	37	7.96
East Rutherford	G	211	1.46	145	1.46 (1)
	H	17	2.31	7	-
	I	-	3.26	-	-
	J	182	2.46	75	2.46
	K	-	1.33	-	-
	L	141	2.55	55	2.55
Subtotal		551	13.37	41	6.47
Rutherford	M	65	3.42	19	2.61
	N	19	2.17	9	-
	O	11	1.83	6	-
	P	22	1.66	13	1.18
	Q	48	1.64	25	1.64
	R	43	3.92	11	1.54
	S	11	1.65	7	-
	T	5	1.84	3	-
	U	35	0.94	42	0.94 (1)
Subtotal		259	19.07	14	7.91
TOTAL (Rounded)		1,305	46.0	28	22.34

(1) Includes short length of sewer in small adjacent unmetered areas.

TABLE 9

JOINT MEETING SERVICE AREA

COST-EFFECTIVENESS OF INFLOW REDUCTION PROGRAM

DESCRIPTION	
Average Inflow	40,000 gpd
Sewer Length	46.0 miles
Unit Average Inflow	870 gpd/mile
Estimated Removable Inflow	28,000 gpd
Unit Benefit of Removal	$18.90/gpd
Benefit of Removal	$529,000
Unit Cost of Removal	$9.64/gpd
Cost of Removal	$270,000
Cost of Testing	$74,000
Total Cost	$344,000
Net Benefit	$185,000
Benefit-Cost Ratio	1.54
Net Benefit per mile	$4,000
Corresponding BCSA priority	II

TABLE 10
BCSA PEAK TO AVERAGE SEWAGE
FLOW RATIOS

AVERAGE FLOW (mgd)	PEAK FACTOR
0.01	15.0
0.02	11.7
0.05	8.6
0.10	6.7
0.20	5.3
0.50	4.1
1.00	3.4
2.00	2.9
5.00	2.5
10.00	2.3
20.00	2.2

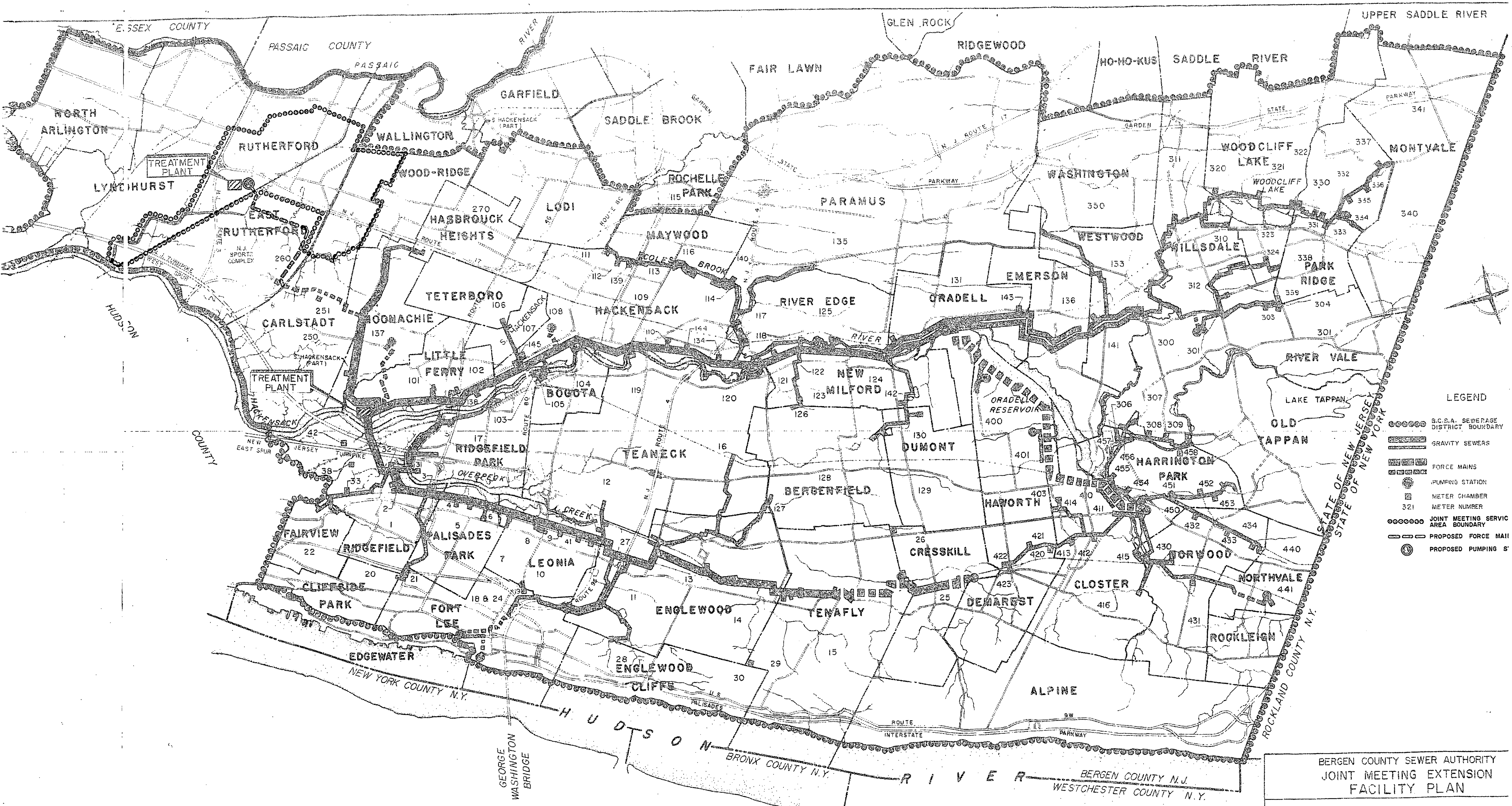
TABLE 11

JOINT MEETING EXTENSION PROJECT COSTS

Item	Costs
	STEP I GRANT
ADMINISTRATION	15,000
PRIOR FACILITY PLAN WORK	47,000
ENGINEERING FEES	258,000 (1)
EQUIPMENT	11,500
CONTINGENCIES	32,650
TOTAL FOR STEP I	365,000
	STEP II GRANT
ADMINISTRATION	15,000
LEGAL AND FISCAL	40,000
VALUE ENGINEERING	25,000
EASEMENTS	15,000
FINAL DESIGN	290,000
INFLOW INVESTIGATION	74,000
CLEANING AND TV'ING	143,000
SURVEY REPORT	22,000
CONTINGENCIES	62,000
15% INCREASE 1977-1978	99,000
TOTAL FOR STEP II	785,000
	STEP III GRANT
METERS	50,000
INFLUENT SEWERS	137,000
27 INCH FORCE MAIN	1,414,000
PUMPING STATION	1,626,000
CONTINGENCIES	323,000
30% INCREASE 1979-1981	1,065,000
ADDITIONAL ENGINEERING	625,000
TOTAL FOR STEP III	5,240,000 (2)
TOTAL FOR STEPS I, II, III	6,390,000

(1) For Facilities Plan, I/I analysis and environmental studies; includes manpower, travel, reproduction, survey, and boring costs; also includes physical survey phase of SSES

(2) Possible sewer system rehabilitation costs are not included.



DISTRICT SEWER SYSTEM

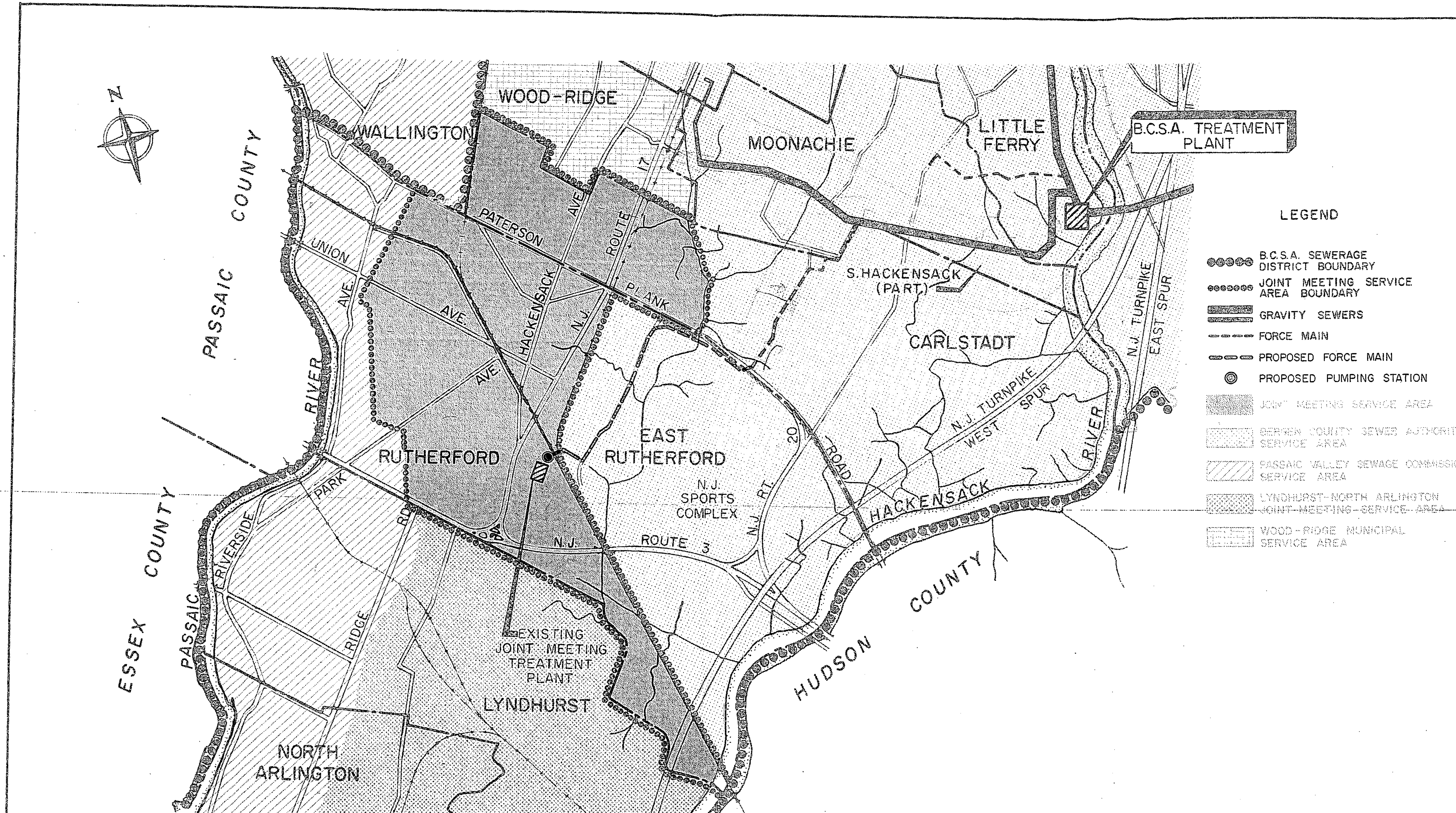
5,000 0 5,000 10,000
SCALE IN FEET

BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

LOCALITY MAP

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLA

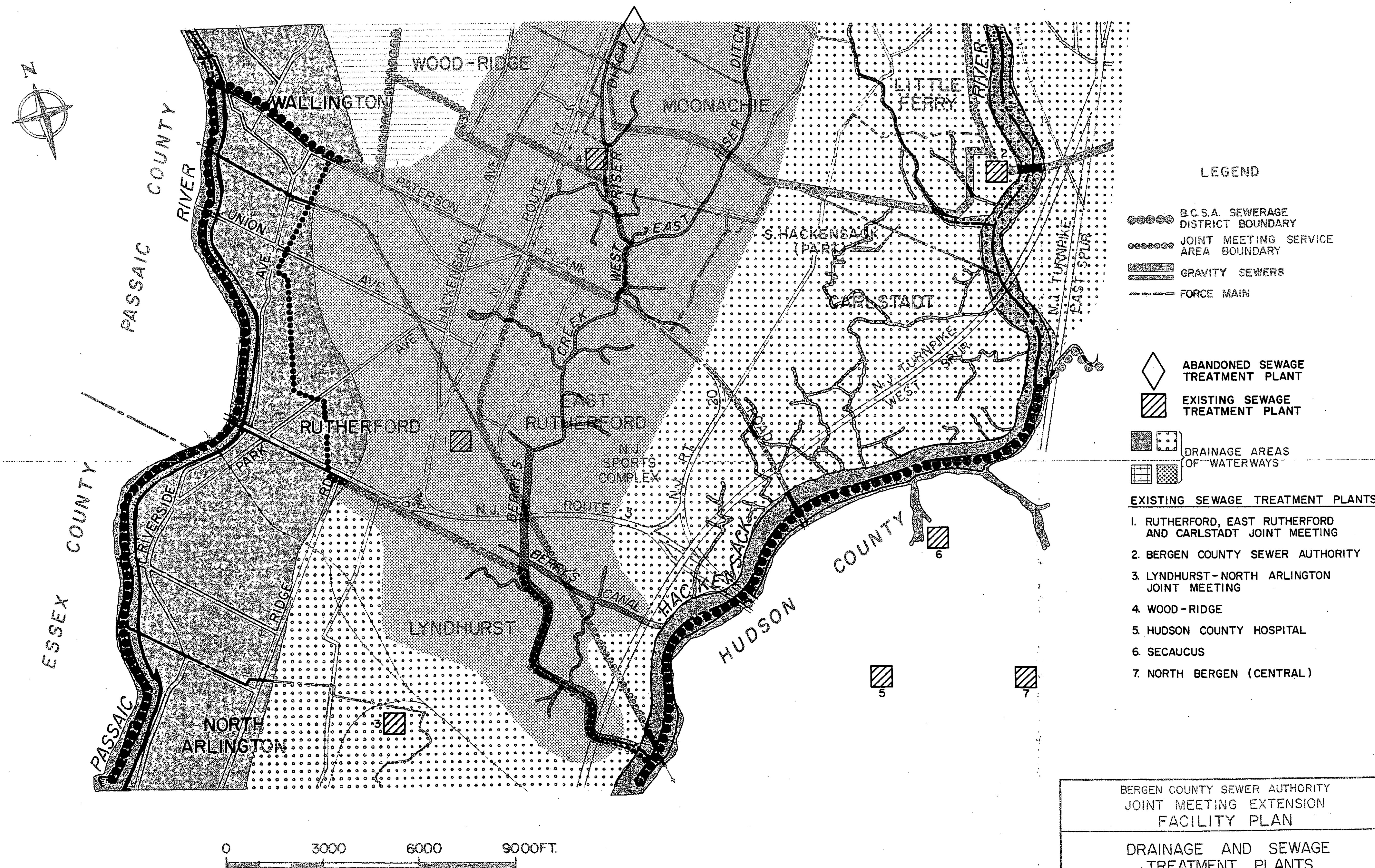


BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

PRESENT SERVICE AREA

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 2

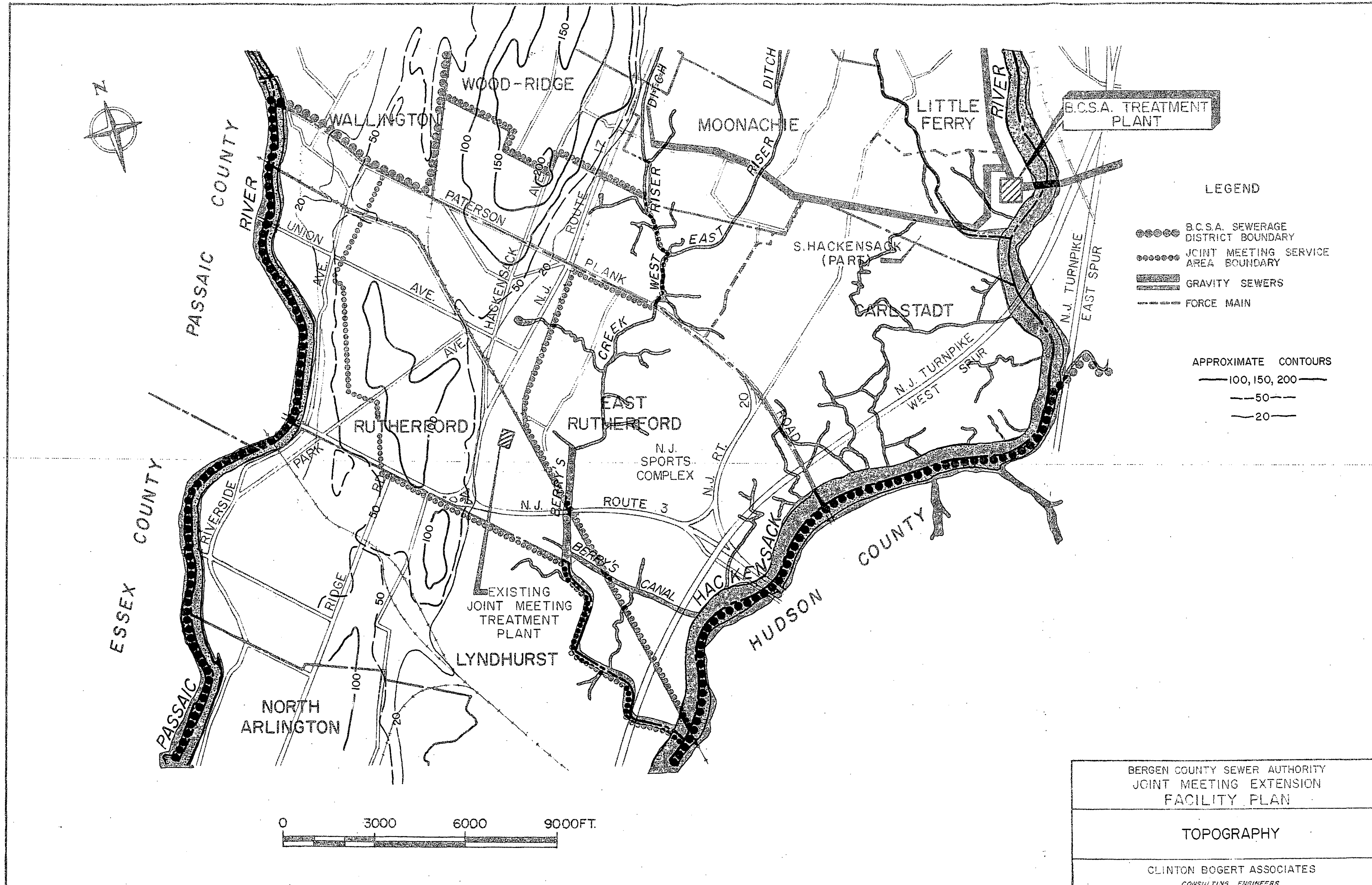


BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

DRAINAGE AND SEWAGE TREATMENT PLANTS

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

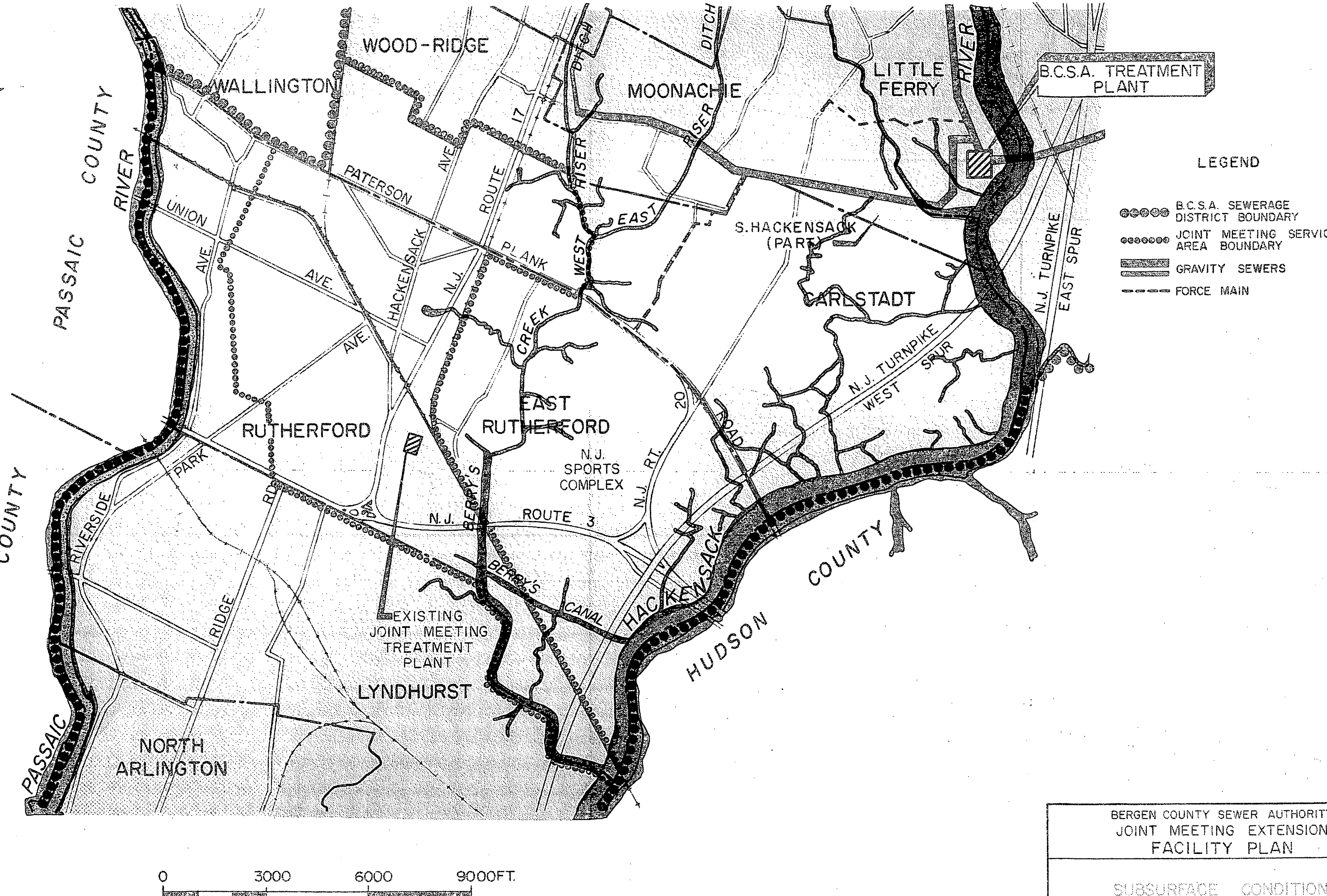
PLATE 3



BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

TOPOGRAPHY

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS



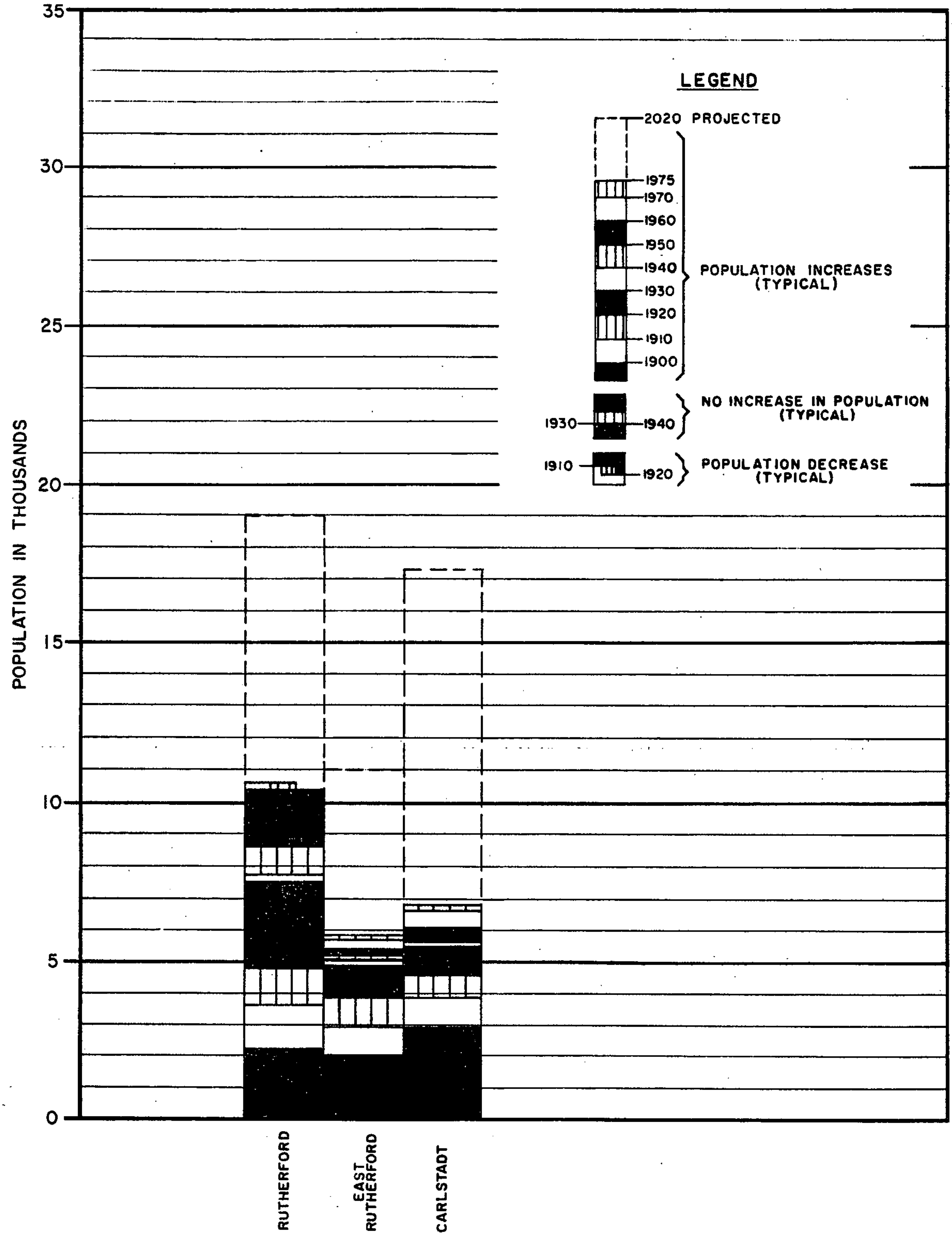
BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

SUBSURFACE CONDITIONS

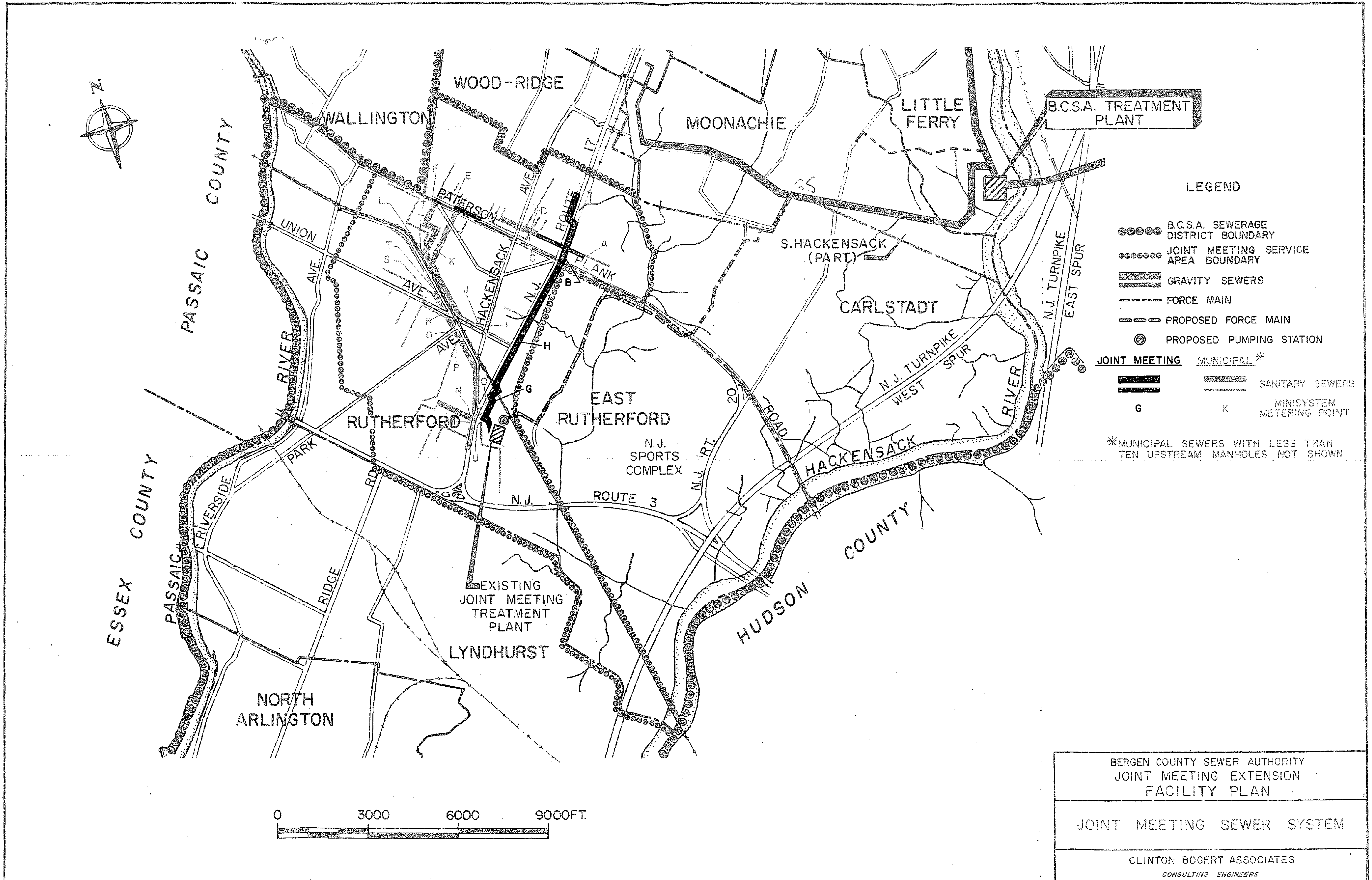
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 5

JOINT MEETING EXTENSION
FACILITY PLAN



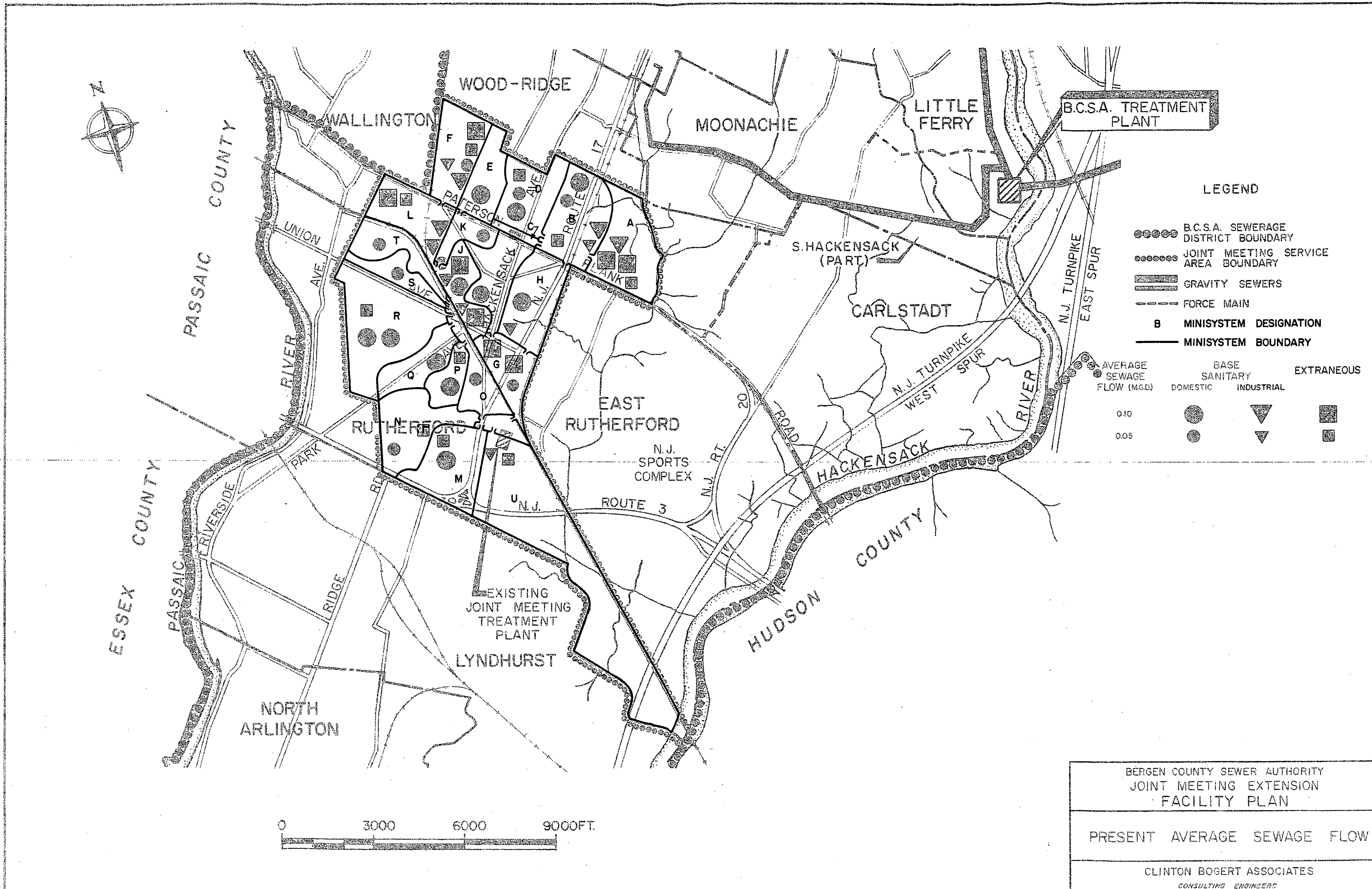
JOINT MEETING POPULATION GROWTH



BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

JOINT MEETING SEWER SYSTEM

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

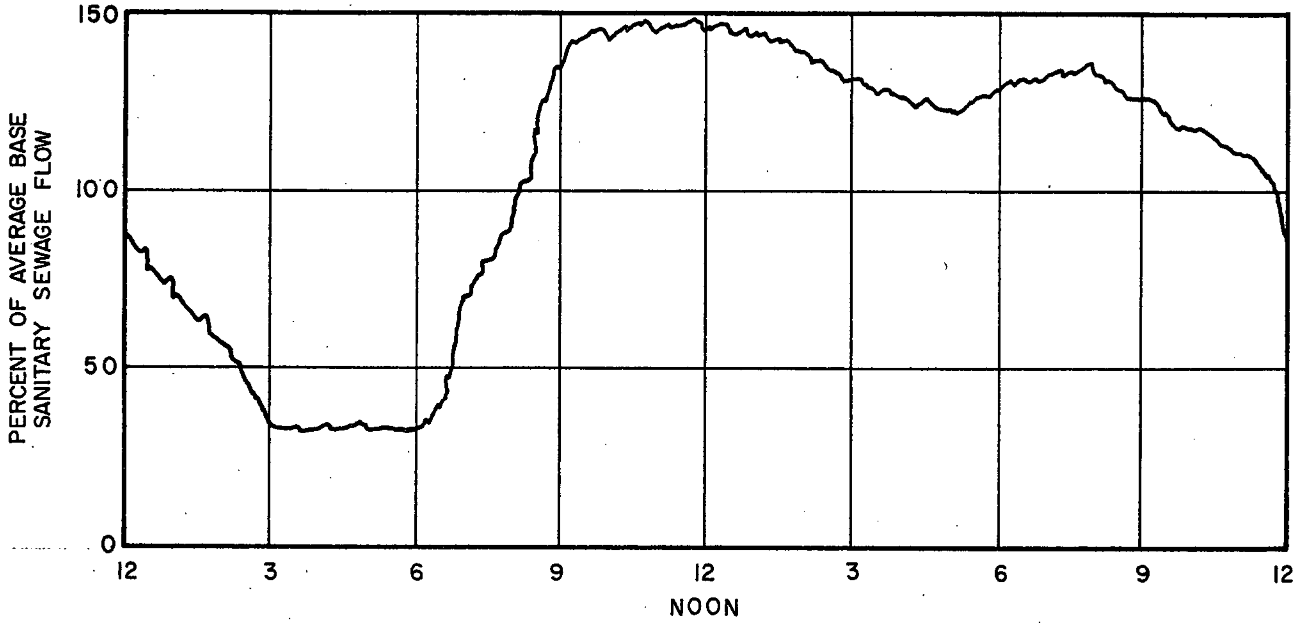


BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

PRESENT AVERAGE SEWAGE FLOW

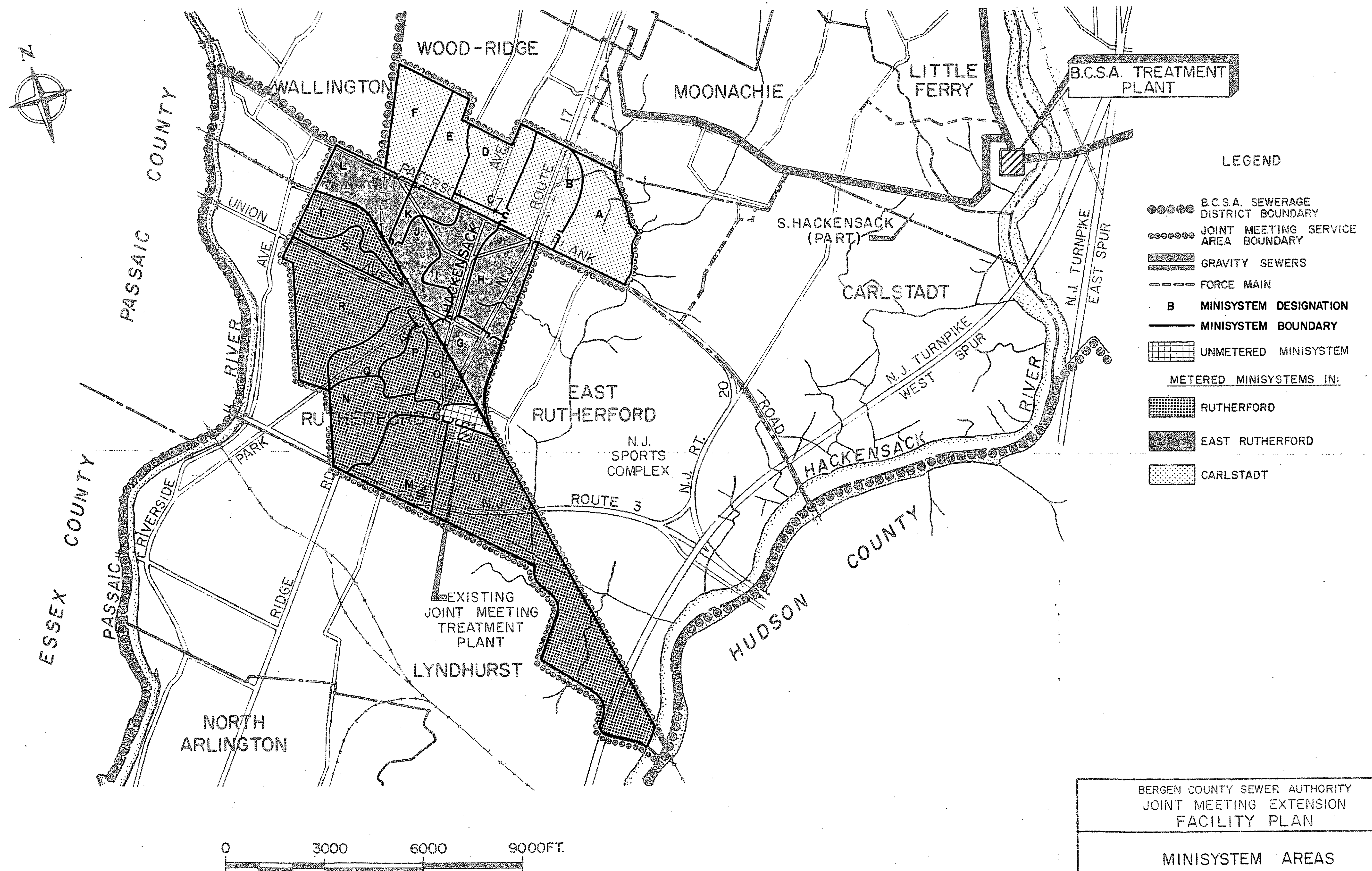
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 8



AT JOINT MEETING TREATMENT PLANT

WEEKDAY BASE SANITARY
SEWAGE FLOW PATTERN
(EXCLUDING INFILTRATION / INFLOW)

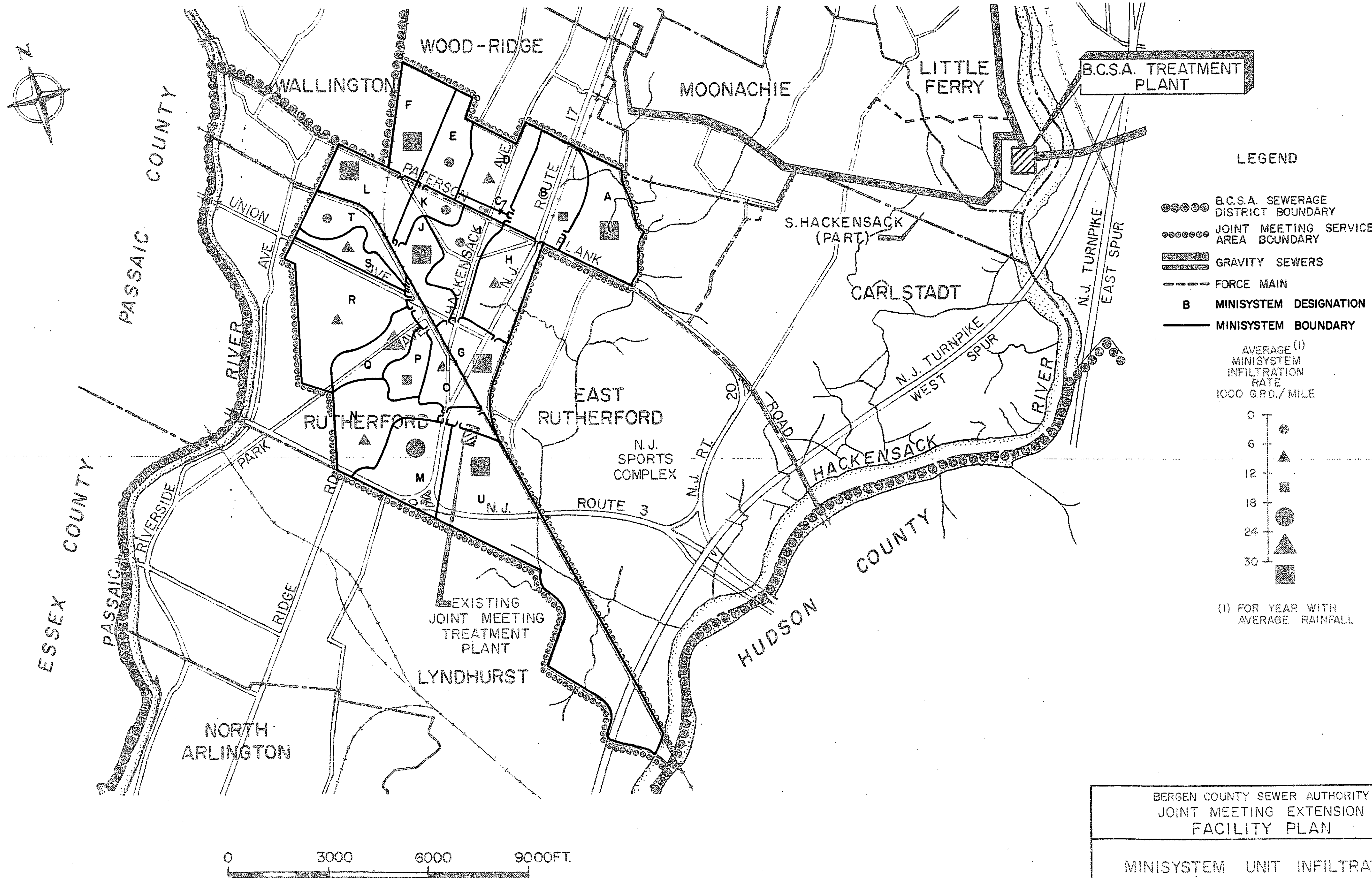


BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

MINISYSTEM AREAS

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 10

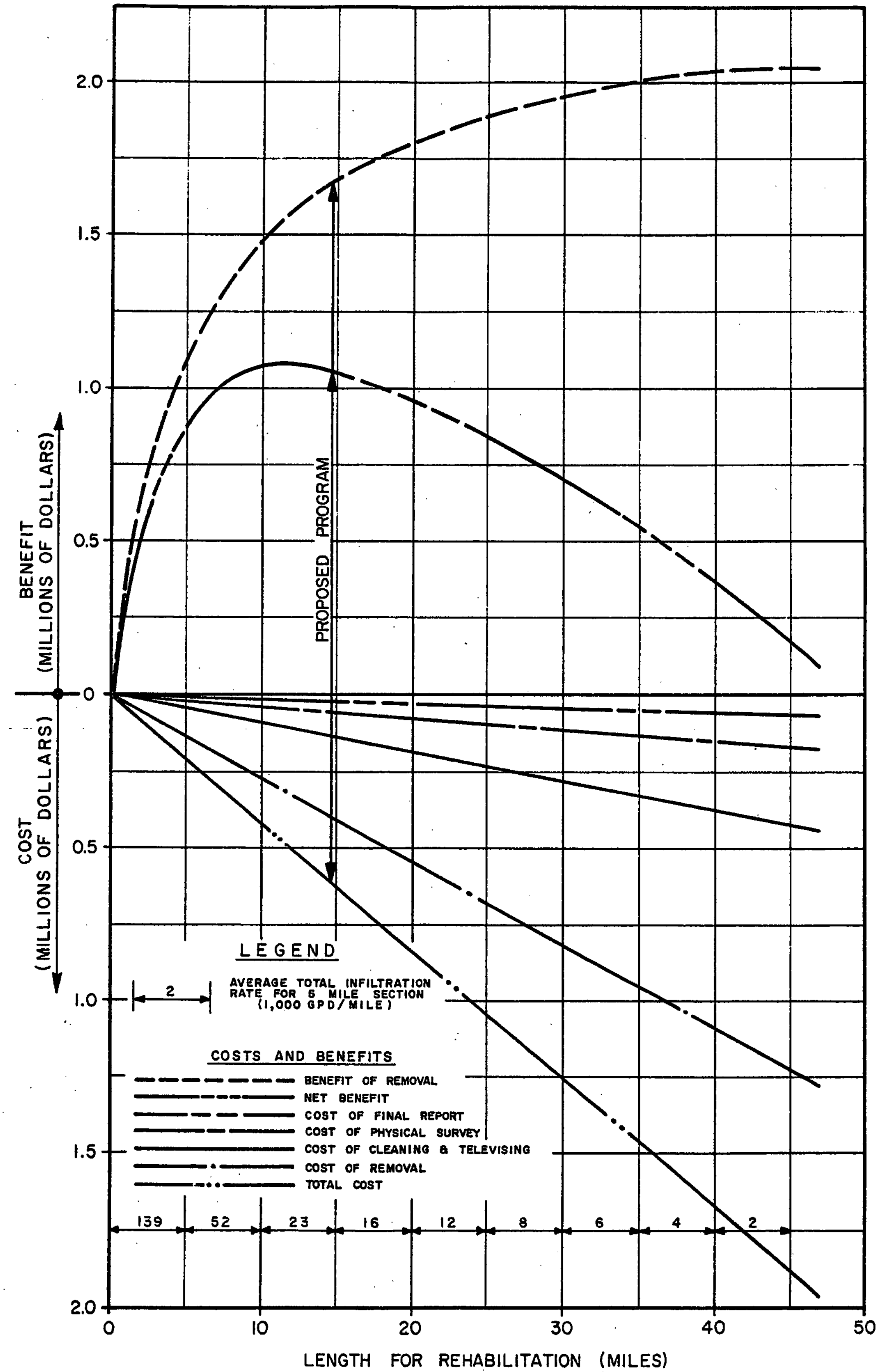


BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

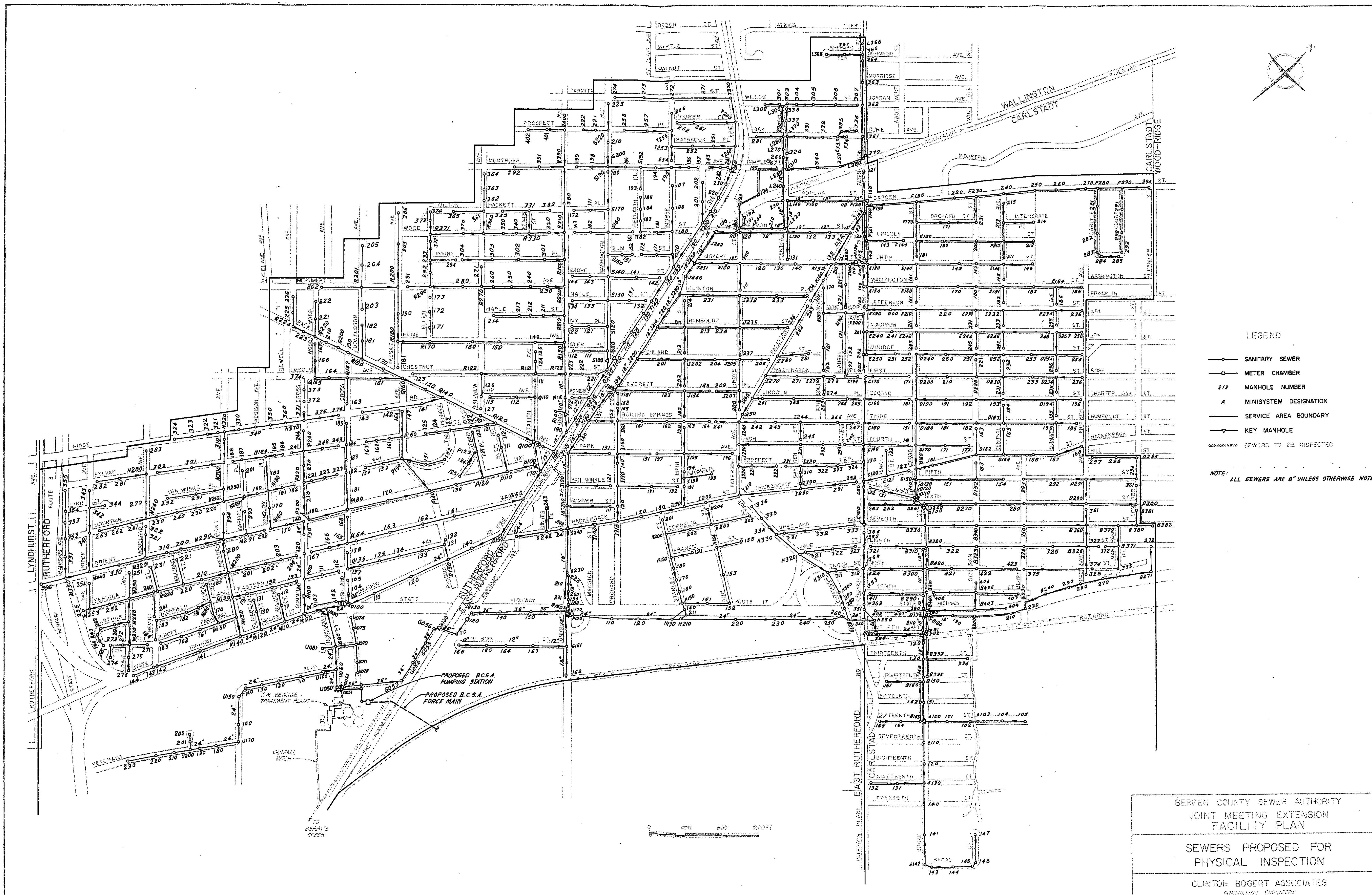
MINISYSTEM UNIT INFILTRATION

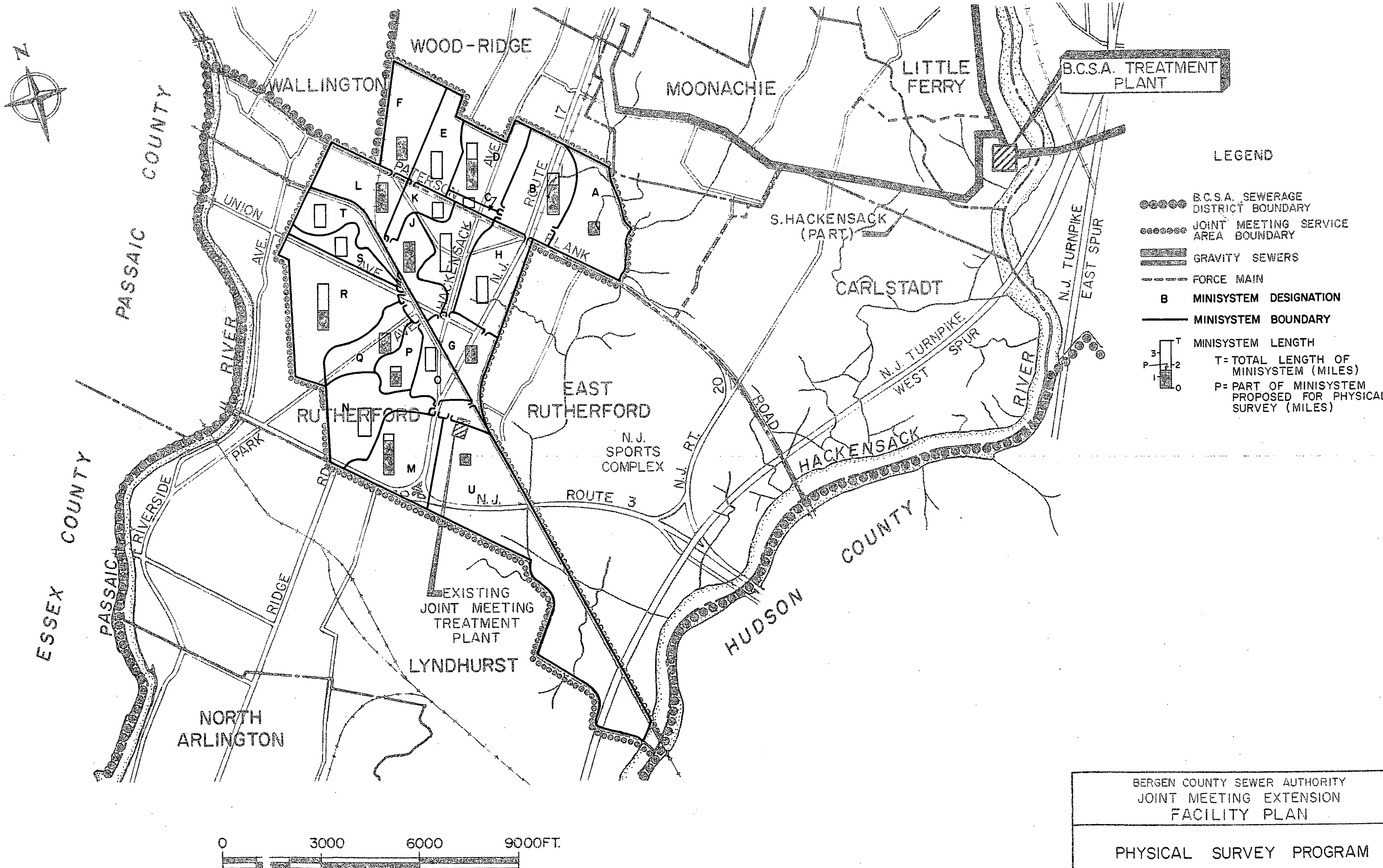
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 12



COSTS AND BENEFITS OF
INFILTRATION REDUCTION PROGRAM


LEGEND
SANITARY SEWER
METER CHAMBER
212 MANHOLE NUMBER
A MINISYSTEM DESIGNATION
SERVICE AREA BOUNDARY
KEY MANHOLE
SEWERS TO BE INSPECTED
NOTE: ALL SEWERS ARE 8" UNLESS OTHERWISE NOTED
PROPOSED B.C.S.A. PUMPING STATION
PROPOSED B.C.S.A. FORCE MAIN
LYNDHURST
RUTHERFORD
EAST RUTHERFORD
CARLSTADT
WOOD-RIDGE
WALLINGTON
BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN
SEWERS PROPOSED FOR PHYSICAL INSPECTION
CLINTON BOGERT ASSOCIATES

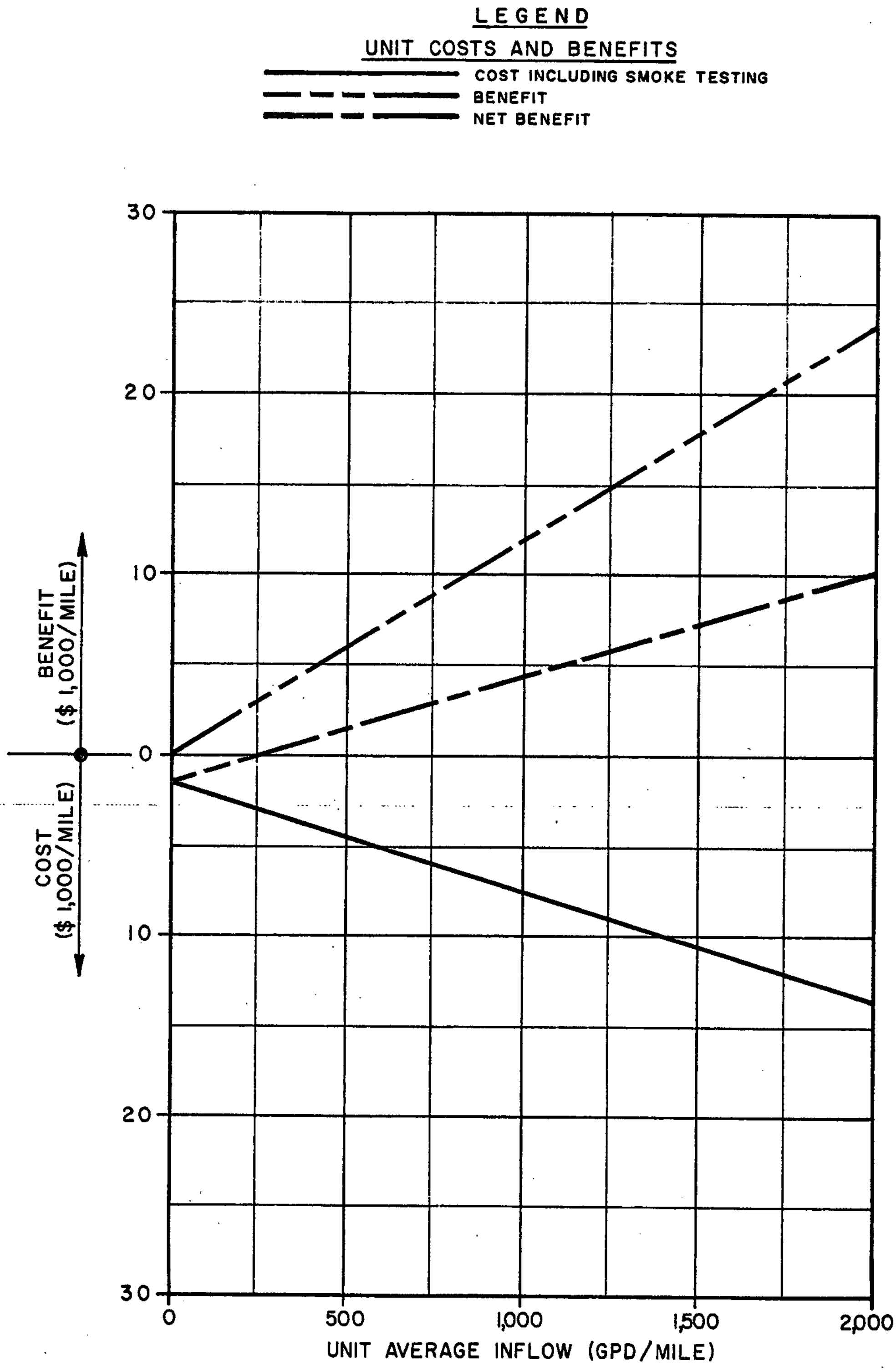


BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

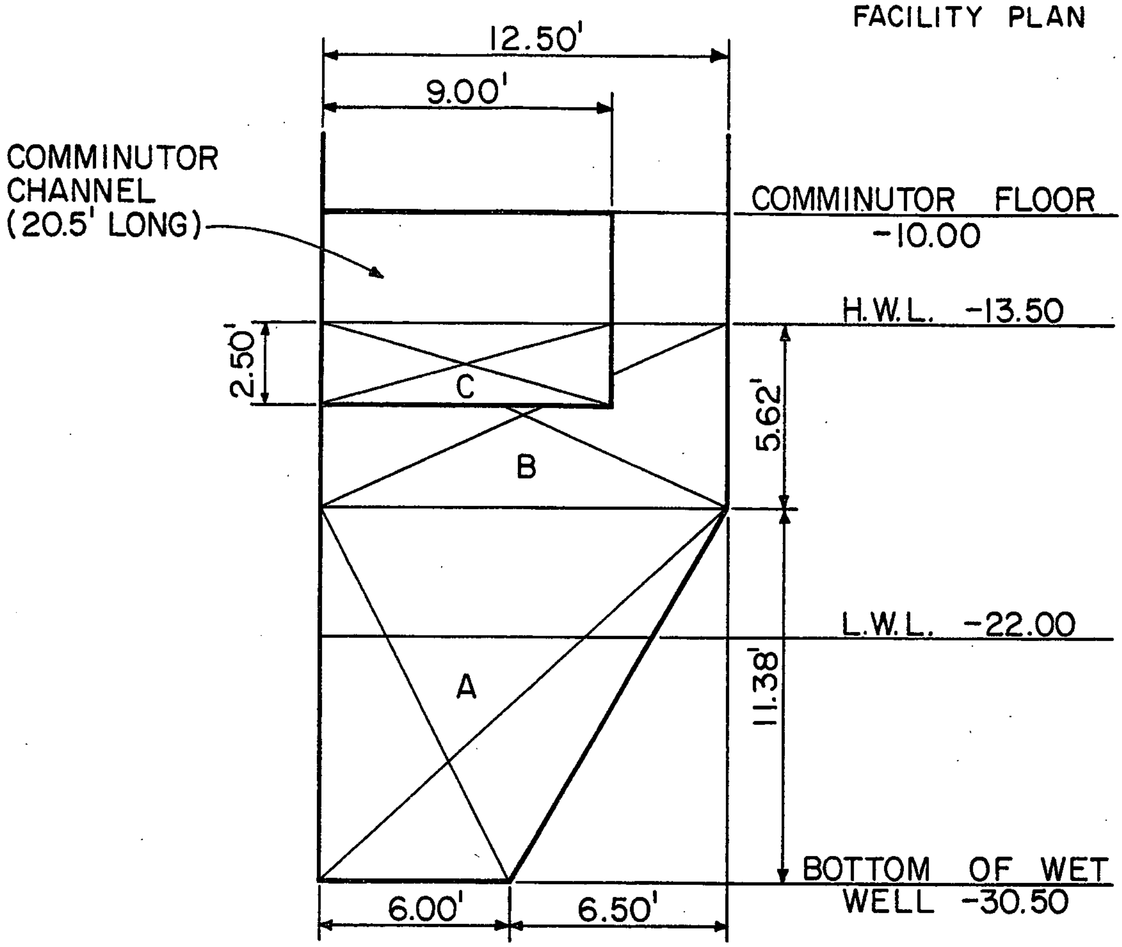
PHYSICAL SURVEY PROGRAM

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS

PLATE 15



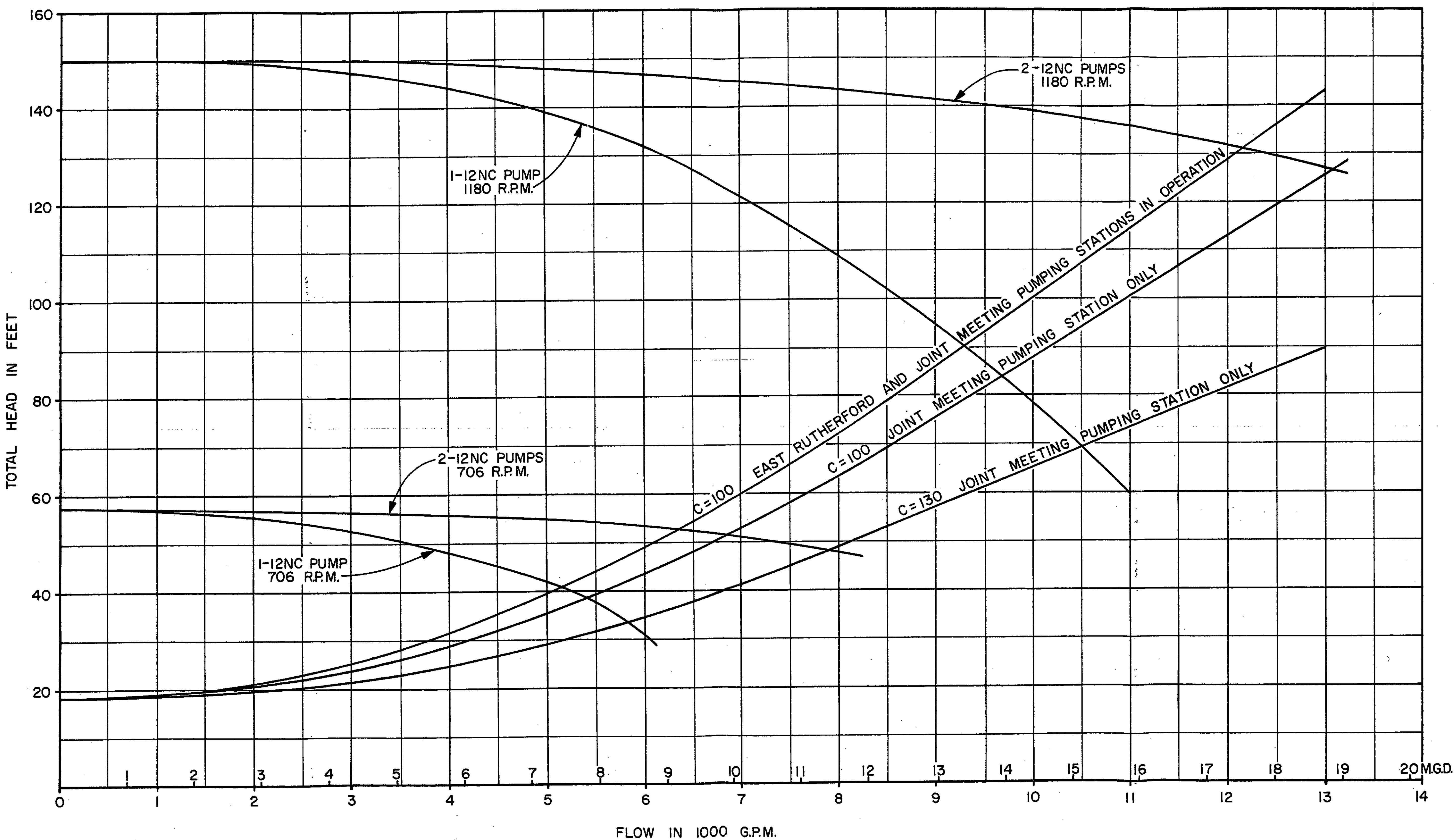
UNIT COSTS AND BENEFITS
OF INFLOW REMOVAL



DESIGN YEAR	2020
AVERAGE FLOW	5,111 G.P.M.
CROSS SECTIONAL AREA	A+B =175.50 SQ. FT.
LENGTH OF WET WELL	33.50 FT.
WET WELL CAPACITY	43,977 GAL.
REDUCTION OF VOLUME "C"	3,450 GAL.
REDUCTION OF VOLUME FOR SLOPE ENDS	2,185 GAL.
TOTAL CAPACITY	38,342 GAL.
WET WELL DETENTION TIME	$\frac{38,342}{5,111}$ = 7.5 MIN.

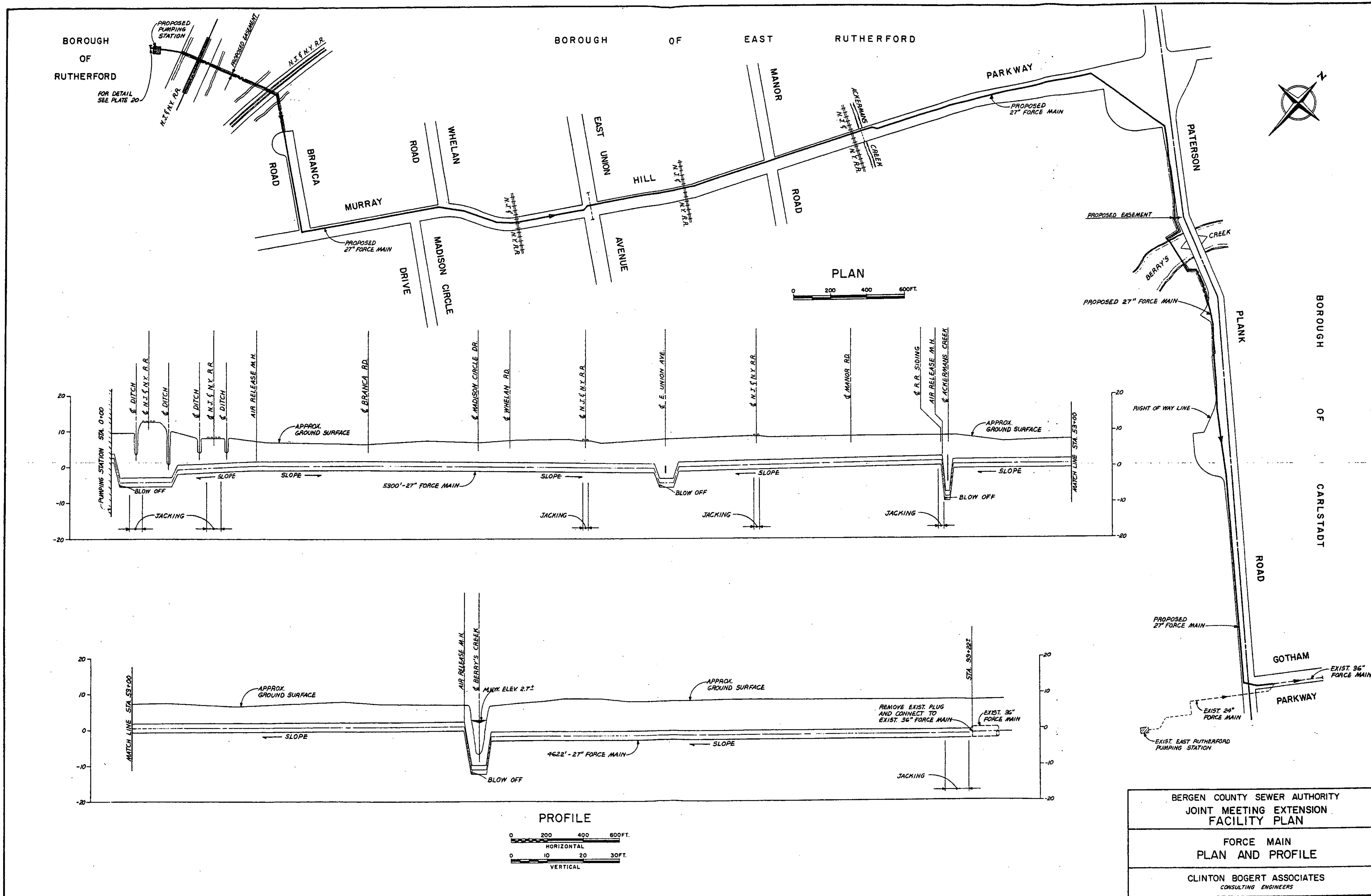
WET WELL CROSS-SECTION
AND CAPACITY

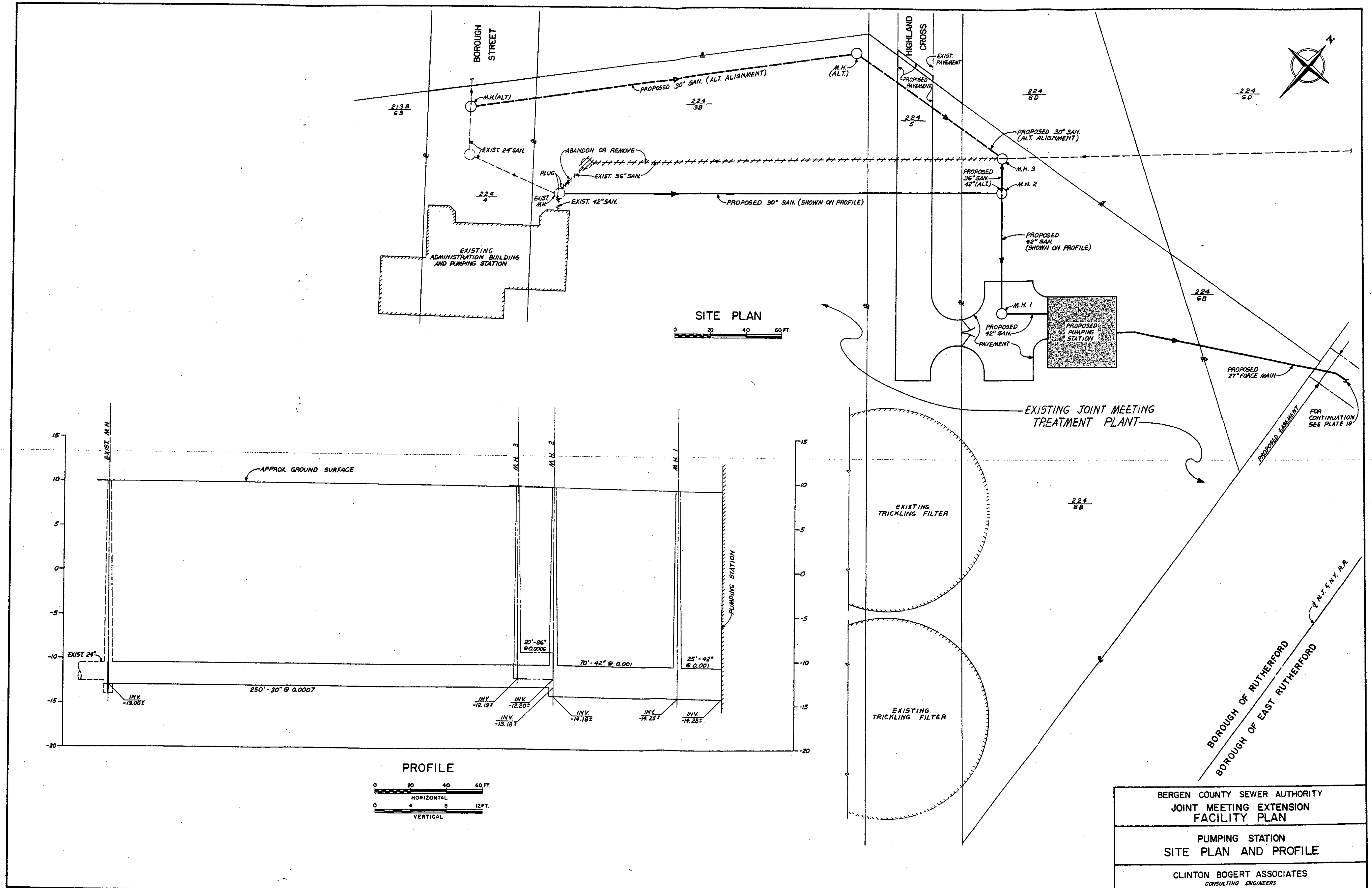
PUMPING STATION

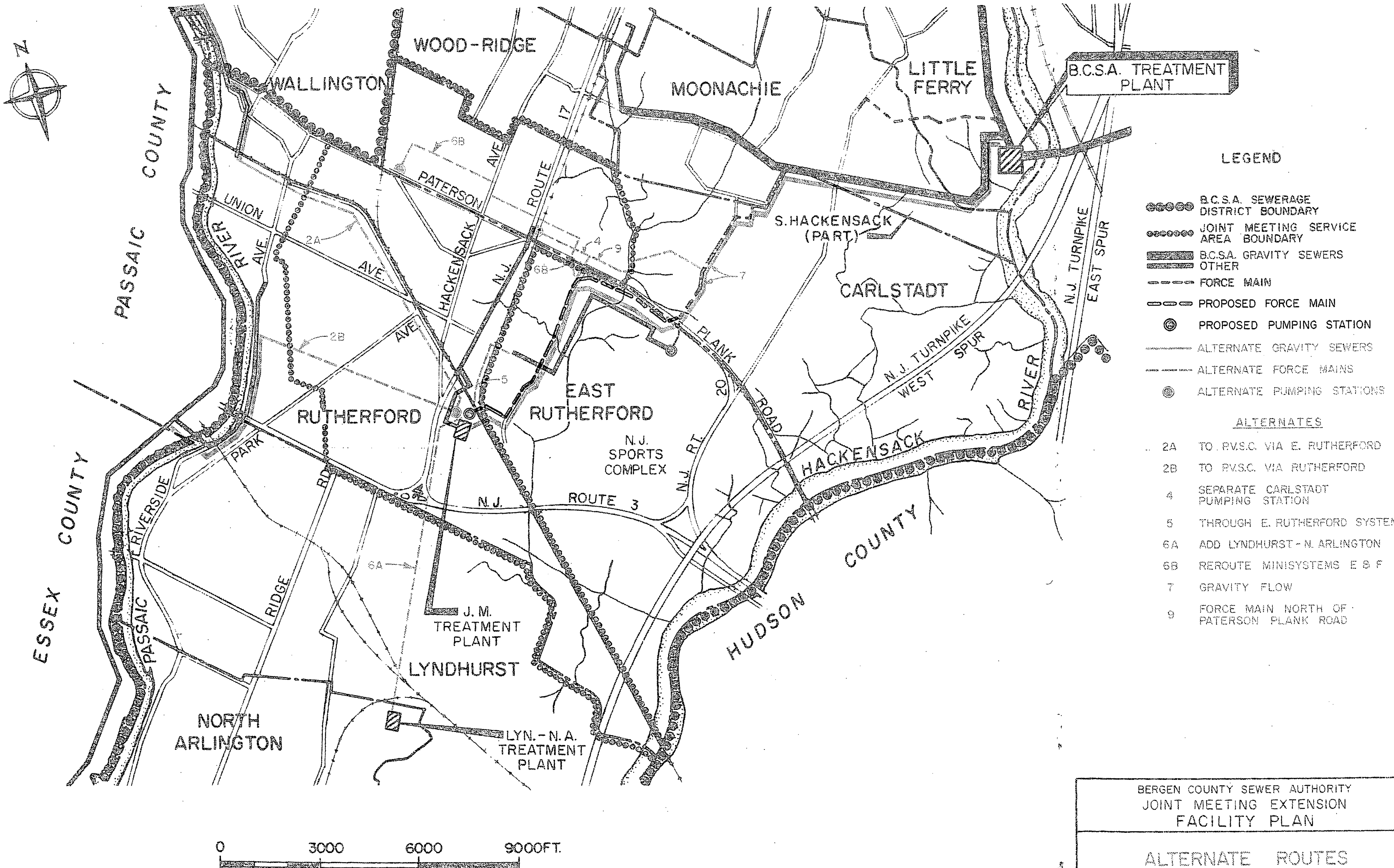


SYSTEM HEAD CURVES

CLINTON BOGERT ASSOCIATES


BOROUGH OF RUTHERFORD
PROPOSED PUMPING STATION
FOR DETAIL SEE PLATE 20
PROPOSED EASEMENT
N.J. & N.Y. R.R.
BOROUGH OF EAST RUTHERFORD
BRANCA ROAD
MURRAY
WHELAN ROAD
MADISON CIRCLE DRIVE
EAST UNION AVENUE
HILL
MANOR ROAD
ACKERMANS CREEK
PARKWAY
PROPOSED 27" FORCE MAIN
PATERSON PLANK ROAD
PROPOSED EASEMENT
BERRY'S CREEK
RIGHT OF WAY LINE
BOROUGH OF CARLSTADT
PLAN
0 200 400 600FT.
GOTHAM PARKWAY
EXIST. 36" FORCE MAIN
EXIST. 24" FORCE MAIN
EXIST. EAST RUTHERFORD PUMPING STATION
PUMPING STATION STA. 0+00
℄ DITCH
℄ N.J. & N.Y. R.R.
AIR RELEASE M.H.
℄ BRANCA RD.
℄ MADISON CIRCLE DR.
℄ WHELAN RD.
℄ E. UNION AVE.
℄ MANOR RD.
℄ R.R. SIDING
℄ ACKERMANS CREEK
APPROX. GROUND SURFACE
SLOPE
5300'-27" FORCE MAIN
BLOW OFF
JACKING
MATCH LINE STA. 53+00
℄ BERRY'S CREEK
M.H.W. ELEV. 2.7±
4622'-27" FORCE MAIN
REMOVE EXIST. PLUG AND CONNECT TO EXIST. 36" FORCE MAIN
STA. 99+22±
PROFILE
0 200 400 600FT. HORIZONTAL
0 10 20 30FT. VERTICAL
BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN
FORCE MAIN
PLAN AND PROFILE
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS


BOROUGH STREET
HIGHLAND CROSS
EXIST. PAVEMENT
PROPOSED PAVEMENT
M.H. (ALT.)
PROPOSED 30" SAN. (ALT. ALIGNMENT)
219B 63
224 3B
224 5
224 8D
224 6D
224 4
224 6B
224 8B
EXIST. 24" SAN.
ABANDON OR REMOVE
PLUG
EXIST. 36" SAN.
EXIST. M.H.
EXIST. 42" SAN.
PROPOSED 30" SAN. (SHOWN ON PROFILE)
M.H. 3
M.H. 2
PROPOSED 36" SAN. 42" (ALT.)
PROPOSED 42" SAN. (SHOWN ON PROFILE)
M.H. 1
PROPOSED 42" SAN.
PAVEMENT
PROPOSED PUMPING STATION
PROPOSED 27" FORCE MAIN
FOR CONTINUATION SEE PLATE 19
PROPOSED EASEMENT
EXISTING ADMINISTRATION BUILDING AND PUMPING STATION
SITE PLAN
0 20 40 60 FT.
EXISTING JOINT MEETING TREATMENT PLANT
EXISTING TRICKLING FILTER
EXISTING TRICKLING FILTER
BOROUGH OF RUTHERFORD
BOROUGH OF EAST RUTHERFORD
℄ N.J. & N.Y. R.R.
EXIST. M.H.
M.H. 3
M.H. 2
M.H. 1
APPROX. GROUND SURFACE
PUMPING STATION
EXIST. 24"
20'-36" @ 0.0006
70'-42" @ 0.001
25'-42" @ 0.001
250'-30" @ 0.0007
INV. -13.00±
INV. -12.19±
INV. -12.20±
INV. -13.18±
INV. -14.18±
INV. -14.25±
INV. -14.28±
15
10
5
0
-5
-10
-15
-20
PROFILE
0 20 40 60 FT.
HORIZONTAL
0 4 8 12 FT.
VERTICAL
BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN
PUMPING STATION
SITE PLAN AND PROFILE
CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS



BERGEN COUNTY SEWER AUTHORITY
JOINT MEETING EXTENSION
FACILITY PLAN

ALTERNATE ROUTES

CLINTON BOGERT ASSOCIATES
CONSULTING ENGINEERS